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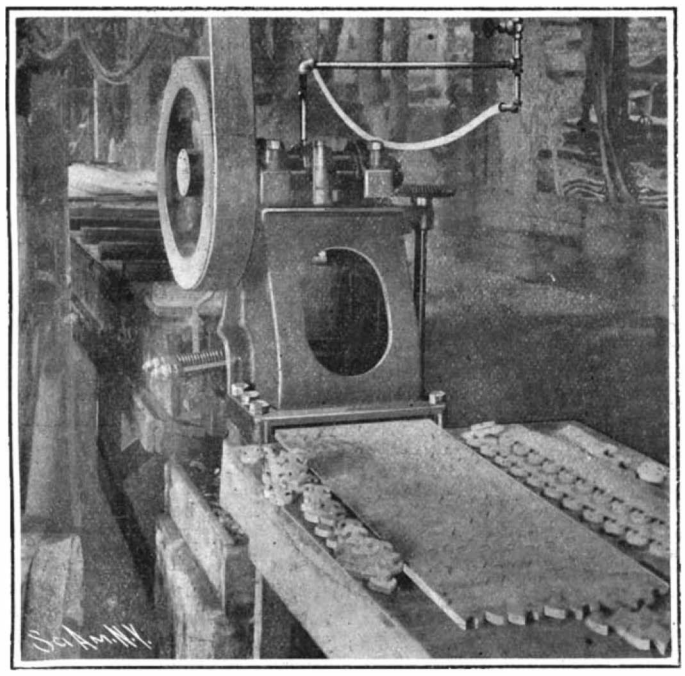
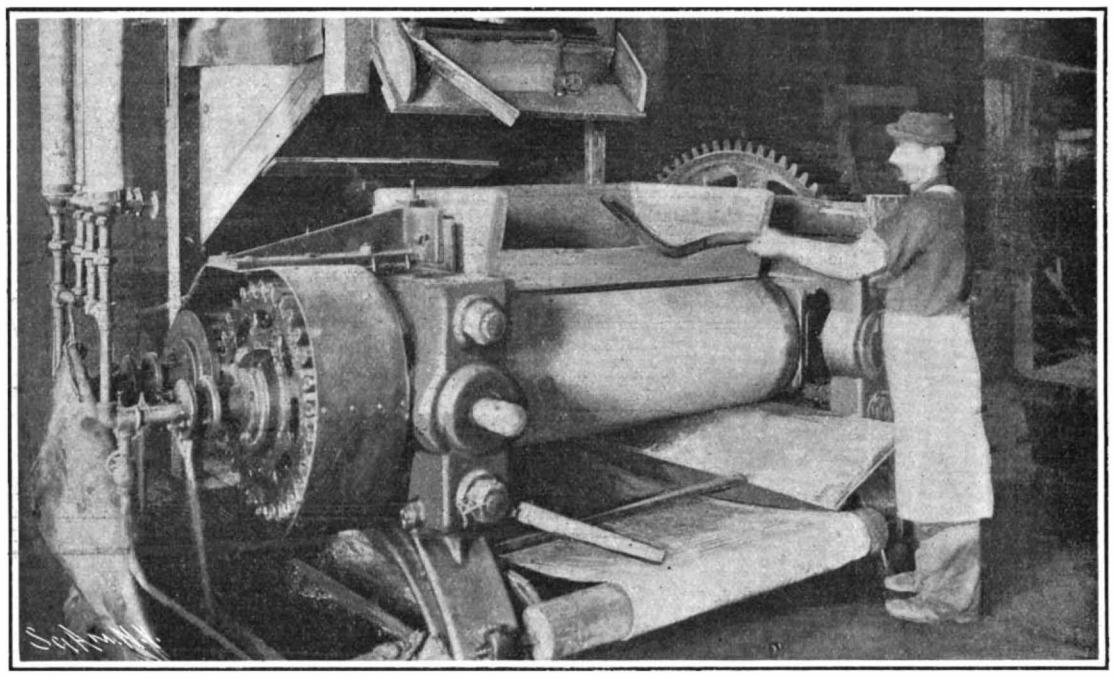
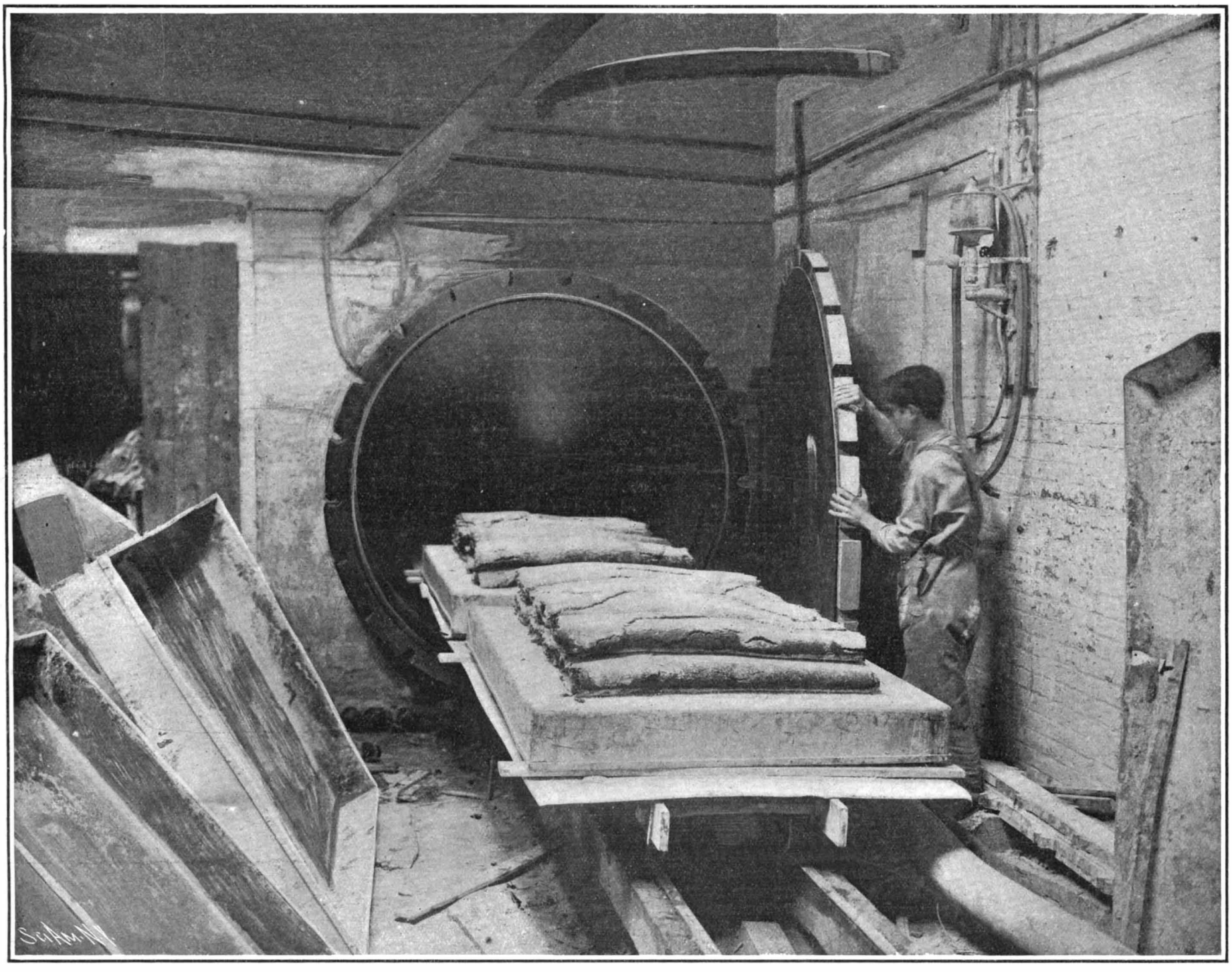


Machine for Cutting Out Rubber Tiles.



Machine in Which the Scrap Rubber is Ground and Sifted.



Running a Load of "Rubber Shoddy" Into the Devulcanizing Cylinder Where, Under Action of Steam Heat, the Sulphur is Extracted.

MANUFACTURE OF MECHANICAL RUBBER GOODS.—[See page 240.]

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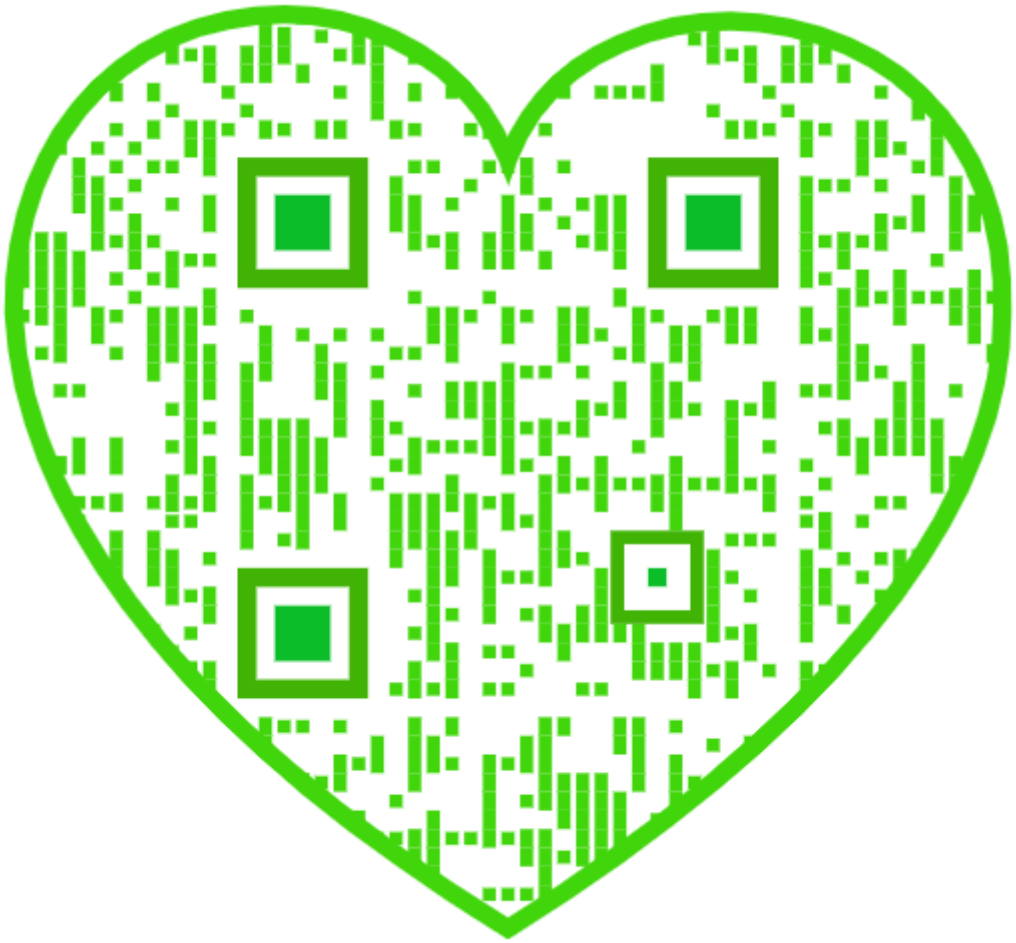

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NEW YORK, SATURDAY, OCTOBER 5, 1907.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

PROGRESS ON THE PANAMA CANAL.

It is certainly good news to learn that progress on the Panama Canal has been so rapid that the Isthmian Canal Commission has thought wise to ask for about eight million dollars, in addition to the appropriations already made, in order that the present working force may be permitted to go ahead uninterruptedly at the high rate of speed which has characterized operations during the past few months.

It will be remembered that in the preliminary estimates of the quantities of excavation and the time for completion of the canal, the engineers were agreed that the determining time-factor was the excavation of the great Culebra cut. It was agreed that whatever speed might be made in the construction of harbors, dams, locks, and other works incidental to the canal, the question of the date of final completion would be determined solely by the speed with which the huge cutting could be made through the mountain divide.

It seems, however, that the American steam shovel, which has now been installed in large numbers at the cut, is living nobly up to its reputation, and that the plan of excavation, including the arrangement of various levels and tracks worked out by the late Chief Engineer Stevens, has proved so thoroughly adequate, that the time of completion of the cut is going to be very much shortened. This being the case, it is now recognized that the determining factor will be the huge dam and the equally stupendous canal locks at Gatun; and now that the Culebra excavation is swinging along on a set routine, it is the purpose of the Commission to bend every effort to expediting the construction of the locks and dam.

The Isthmian Canal Commission makes the public statement that with the present fine organization, and at the present rate of progress, the canal can be completed more rapidly than by restraining expenditure within the appropriations which were made at the last session of Congress to continue the work until 1908. The work on the locks and dams on each terminus has been opened, and will be pushed vigorously during the year, while very little was expended at those places during the fiscal year which terminated June 30, 1907. The time of completion of the canal, says the Commission, appears to depend now upon work at Gatun, rather than upon the work of excavation, which has hitherto been generally taken as the determining feature. The progress in this direction has been faster than anticipated, and the appropriation made at the last session of Congress would not be sufficient to supply the necessary plant to begin laying the concrete in the locks and dams during the next fiscal year, although progress already made indicates that such a beginning is advisable.

In order to avoid reducing the force to keep within the expenditure already authorized for this fiscal year, the chairman of the Commission has recommended to the Secretary of War that the work be allowed to proceed, and that Congress be appealed to at its next session to make good any deficiency in the funds now available. If the funds requested are not provided, it will, of course, be necessary to reduce the rate of expenditure to keep within the appropriations on hand. About $8,000,000 in excess of the appropriations already made could be used to advantage in pushing forward the work during the present year.

The work on the locks and dams has now progressed to a point at which it is possible to see something of their form. Four steam shovels are digging out the site for the locks, and construction can be begun as soon as the excavation of the top lock of the flight is completed. The present indications are that the actual masonry work can be begun in about a year and a half's time. Two steam shovels are preparing the site for the erection of the spillway works, which are to be built in elevated ground located at about the center of the big dam. Railroad trestles are being erected across the line that will mark the inside and outside boundaries of the dam, and from one of these, dirt trains are already at work dumping material upon the site of the dam. The Chagres River has been diverted from its main channel and dammed, this work being preparatory to the installation of the pipe-line dredges, with which the greater part of the dam will be constructed. It is expected that these dredges will be installed by the first of next year, by which time work will be in full swing as actively at Gatun as it now is at Culebra.

It is gratifying to learn that suitable sand and rock for the big masonry locks have been located, and, what is of scarcely less importance, materials for the manufacture of all the necessary cement have been located at the Isthmus. This gives the Commission a strong position on the cement question; although it is hoped that this material can be secured for such a reasonable price in the United States as to render it unnecessary for the government to take up its manufacture at the Isthmus.

The general features and the design and details, not only of the Gatun, but also of the other locks throughout the Isthmus, have been determined upon and fully worked out, together with the general type and number of lock gates to be used. The survey of the country which will be inundated by the great Gatun Lake has been completed, and all the contour lines established. The area of the lake has been a growing quantity during these past few months, but it has now been finally established at the high figure of 171 square miles.

THE "AMERICA" CUP CHALLENGE.

True lovers of yachting must surely regret the action of the New York Yacht Club in declining to accept Sir Thomas Lipton's challenge to race for the "America" cup with a 68-foot boat under the new rules of the New York Yacht Club and must also concur with him that another contest under the old rules with exaggerated types again imposes unnecessary hardships on the challenger and compels him to send across the Atlantic, at considerable peril to its crew, a boat which was never intended for so protracted a voyage. The club's position in declining to accept a challenge for a contest with any but 90-foot freaks seems decidedly inconsistent with the pains which it took to formulate a code of rules for the express purpose of producing a wholesome yacht, seaworthy and yet fast, and capable, after a series of races, of being converted into a comfortable cruiser. The club's decision is all the more regrettable because the vessels built under the new rules are decided improvements on their predecessors.

Inasmuch as Sir Thomas has declared that he will not challenge under the old rules because Fife and Milne have expressed their unwillingness to out-"Shamrock" the last "Shamrock," and inasmuch as the New York Yacht Club is not likely to recede ingloriously from its position, the prospects of future cup races are not over-bright.

The effect of the club's decision will be deplorable. Despite the number of our wealthy men, very few Americans can afford to construct and maintain a racing craft of the eccentric proportions of "Reliance." Sir Thomas Lipton has waited for some years before challenging again in order that some other contestant might have his chance at winning the "America" cup. He is at present the only man on the other side who seems able to gratify his yachting desire so far as cup races are concerned. If "America" cup races are to remain the sport of only the very wealthy, and if challengers are fewer and poorer than defenders, they must inevitably remain comparatively infrequent. Had the challenge for 68-footers been accepted, the conditions would have been changed, and for the better. At least half a dozen and perhaps a dozen men would have come forward with sound, seaworthy boats. The races of 1908 would have been the most memorable in the history of the most prized trophy in the world.

A PROPOSED HUDSON-FULTON CELEBRATION.

In 1906 a commission was appointed by the Governor of New York State and the Mayor of New York to arrange plans for a fitting celebration in honor of the man who first sailed up the Hudson, and the man who inaugurated the first steamboat service. A committee appointed by this commission has just issued a number of suggestions as to the plan and scope of the exercises.

The date selected, September 18 to September 25, 1909, combines historical propriety and popular convenience. Hudson reached his "farthest north" in the exploration of the river with the "Half Moon" on September 19, 1609, and started down stream on his return voyage on September 23. The days selected for the celebration therefore embrace the 300th anniversary of the culmination of his great voyage. While the epoch-marking first trip of Fulton's "Clermont" was made in August, 1807, propriety is lent to its commemoration in 1909, not only by the fact that Hudson's and Fulton's achievements are indissolubly wedded to the same great water course, but also by the fact that in 1809 the Legislature of the State of New York was so convinced of the practicability and value of Fulton's invention, that it granted him a monopoly of the navigation of the river.

In addition to the usual religious services, receptions, river parade, illuminations, etc., the committee suggests a very practical dedication day, recommending that Thursday in Celebration Week be devoted to the dedication of parks and memorials along the Hudson River; and that between now and then, the most earnest efforts be made to secure not only the great memorials like Inwood Hill Park, the Hudson Memorial Bridge, the Verplanck's Point Park, the completion of the Palisades Drive, etc., but also that the civic pride of various communities along the river be invoked to participate in like manner according to their means.

TRANSATLANTIC WIRELESS TELEGRAPHY.

The development of wireless telegraphy furnishes a good example of the detail-difficulty which so often bars progress when an invention is at an apparently workable stage. It is almost five years since congratulatory messages were sent, from Cape Cod to Poldhu in Cornwall, to royal persons in Europe; and these were followed by news messages. The good beginning did not continue. Wireless telegraphy was successfully installed on ocean-going steamships, but the wide stretch of the Atlantic could not be commercially bridged. The perfection of detail has cost Mr. Marconi five years of earnest work.

Many extravagant claims have been made in respect of wireless telegraphy. Mr. Marconi has never indulged in this method of exploitation, and so when he does make a statement, it may be accepted as the conservative belief of the man who knows most on the subject. He has just expressed his belief that when these lines are printed commercial messages will be passing between Nova Scotia and Ireland.

New stations have been erected, more powerful than the earlier ones. The American installation is on Cape Breton, the easterly point of Nova Scotia; the European one at Clifden on the west of County Galway, Ireland. The grounds on which success is claimed have not yet been fully made public. Bad weather will apparently be no obstacle, unless the masts and poles at the stations suffer physical damage. We have not heard whether messages will be confined to the dark hours—for in the past daylight has caused a decided loss of energy. And little is known about the clashing of wave frequencies. Unless a number of sending stations can be used simultaneously, sending messages which will be received by their own complements across the Atlantic without in any way affecting other stations, the scope of the work will be limited. But the fact that Mr. Marconi, without indulging in detail, expresses confidence, allows a fair inference that these difficulties have in a certain measure been overcome.

For the present, messages will be sent in the Continental Morse code; but later the ordinary Morse code may be adopted. The speed attainable is not at present as rapid as cable transmission, but it will exceed twenty words a minute. The price fixed for messages is ten cents a word for ordinary messages and five cents a word for press messages. Later these prices may be considerably cut. As the present cable rate is twenty-five cents a word between New York and London, the new system promises seriously to affect the present cable companies.

ALUMINIUM FOR ELECTRIC USES.

Experiments have been made on the Continent with the use of aluminium wire for magnet coil for dynamos and similar purposes, but without any special insulation upon the wire. Instead of this a layer of oxide is formed upon the wire which gives a fairly good insulation between the different turns. At the usual temperature, aluminium becomes covered with oxide when placed in water or steam, and this oxide is hydrated. Commencing at 150 deg. C. (302 deg. F.), the water is driven off, and the oxide is quite anhydrous at 300 deg. C. (572 deg. F.). This gives a layer of alumina which has a good resistance. A coil of aluminium wire is wound in the required form and is then placed in water to receive the layer of oxide. The necessary heat for drying the coil is easily given by passing a current through it. When used in practice, the temperature of the coil should not rise too high. It is found that the insulation will hold good, for low tensions at least, at a temperature below 450 deg. C. (842 deg. F.) on the average, counting 300 deg. C. (572 deg. F.) at the surface of the coil and 600 deg. C. (1112 deg. F.) near the core. Such a coil will have an advantage over the usual coil in being of a smaller size, and the base wire gives a better radiation of heat. Owing to the lighter weight of such coils, they will be of value in the case of revolving parts, where they give a much lower centrifugal force

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THE HEAVENS IN OCTOBER.

BY HENRY NORRIS RUSSELL, PH.D.

Daniel's comet, while still of considerable brightness, has by this time receded from us, and got almost behind the sun, so that it can only be seen in strong twilight just before sunrise. Its orbit appears to be very nearly parabolic, so that it will be a long time before it returns to the sun, if it does so at all.

Large and conspicuous as this comet has been, compared with those of the last few years, it is only one of the second rank, by no means equal to the great comets of 1858 and 1882, for example. Its actual dimensions are, however, very considerable, as its tail was at times not less than 15 million miles in length. Comets are, in fact, the bulkiest members of the solar system; but so far as we know, they are also probably the least massive. This has been proved in many cases by the fact that when a comet has passed very near a planet its attraction has not been great enough to influence the planet's motion to any appreciable degree. While the action of the planet on the comet may have altered the period of the latter by several weeks, the planet's own period has not been changed by so much as a single second; and this proves that the planet's mass must have been at least 100,000 times as great as the comet's. We have, therefore, in a comet a quantity of material very much less than enough to make a planet, spread through a volume far greater than the planet occupies. It is therefore clear that it must consist either of gases of small density, or of solid particles, separated by empty spaces much larger than themselves. It is probable that both these hypotheses are correct, for the spectra of comets show that part of their light is reflected sunlight, such as solid bodies would send us, and part comes from luminous gas—hydrocarbons—giving a series of bright bands identical with those shown by the light from the base of a candle flame or a Bunsen burner.

We may therefore regard a comet as a swarm of loose particles, carrying with them more or less gas, which move together through empty space, simply because there is no force acting to pull them apart, strong enough to overbalance their own very feeble gravitation.

How big the larger particles are we can only guess. They may be yards or even miles in diameter—for it would take over 500,000 bodies a mile in diameter to make up a swarm whose total mass was one-millionth part that of the earth. But some of them must be very much smaller, as is shown by the phenomena of comets' tails. The tail of a comet grows rapidly as it approaches the sun, and evidently consists of matter which has been thrown out from the nucleus, and expelled by some force. What force can we find which is competent to do this? Recent studies have given us the answer: it is simply sunlight.

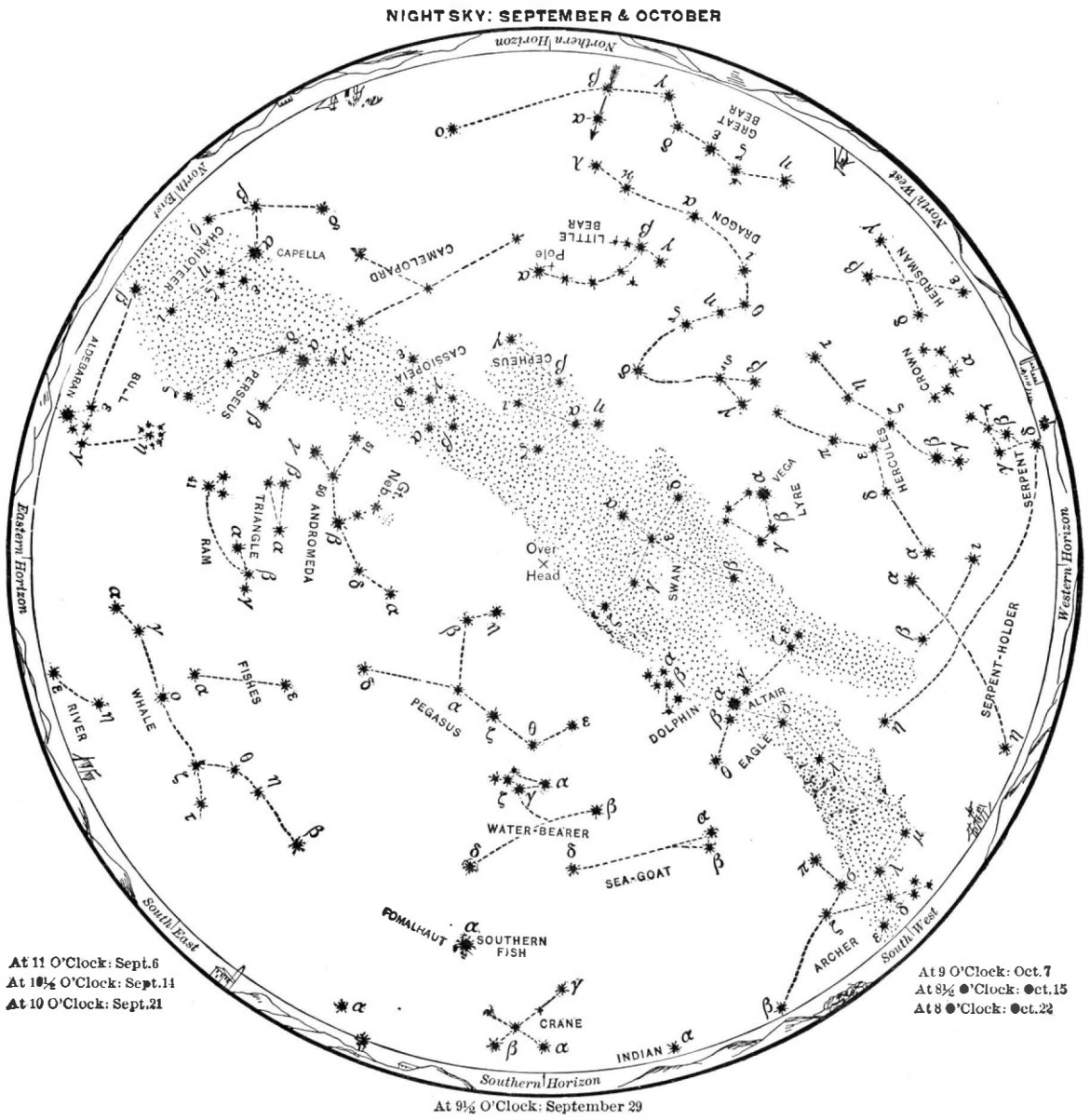
It seems very strange to think of sunlight as exerting pressure; but it was long ago pointed out by the English physicist Maxwell that a surface upon which a beam of light falls is actually subject to a very small pressure, tending to drive it away from the source of light. The amount of this can be calculated from theoretical considerations, and comes out for full sunlight about three pounds per square mile of exposed surface. This is, of course, utterly negligible for all practical purposes. But for very small bodies it ceases to be so. For a ball of stone one inch in diameter at the earth's distance from the sun, the sun's attraction, due to its gravitation, is about 40,000 times as great as the repulsion due to sunlight. But one 1/100 of an inch in diameter will weigh only one-millionth part as much as the first one, and will have a surface one ten-thousandth part as great. The force due to light pressure is proportional to the exposed surface, while that of gravitation varies as the weight. We therefore see that in this case the repulsion will be 1/400 of the attraction; 100 times as large in proportion as for the larger sphere.

For a particle 1/40,000 of an inch in diameter the two forces would balance, and for smaller ones the repulsion would preponderate over the attraction. If the particle moves nearer to the sun, or farther from it, the two faces are increased or diminished in the same ratio, and our conclusion will still be true. While the sun exerts a powerful attraction on the large bodies circulating around it, this attraction is made much feebler, or even changed into repulsion for very small particles, by the pressure of sunlight.

Comets' tails are therefore believed to consist of such very fine particles, which, while the main mass of the comet is approaching the sun, under the influence of the latter's attraction, are repelled by light pressure, and so trail out behind, forming an ever-lengthening train directed away from the sun. This theory has been put to the test of exact numerical calculations, and is found to account not only for the shape and direction of the tail, but for the motions of its parts, in a very satisfactory way.

THE HEAVENS.

With the aid of our map, we may easily find the principal constellations. The Great Dipper is low in the northern sky. Above it is the Dragon, inclosing the Little Bear in his coils. To the left, in the northwest, are the Northern Crown and Hercules, with the brilliant star Vega in the Lyre above them. The bright star farther south, in the Milky Way, is Altair, in the constellation of the Eagle. Low in the southwest, near setting, is Sagittarius the Archer, with the brilliant red planet Mars.



In the map, stars of the first magnitude are eight-pointed; second magnitude, six-pointed; third magnitude, five-pointed, fourth magnitude (a few). four-pointed, fifth magnitude (very few), three-pointed, counting the points only as shown in the solid outline, without the intermediate lines signifying star rays.

The bright star low in the south is Fomalhaut. The Sea Goat and the Water Bearer, above, are dull regions of the sky, but the latter contains the bright planet Saturn, which is about half way between Fomalhaut and the great square in Pegasus.

In the southeast are the Fishes and the huge Whale. The variable star Mira *o* in the latter constellation is beginning to brighten up toward the maximum, which is due in November. It will be interesting to see if it becomes as bright as it did last year, when it was for a short time brighter than any other star in the constellation except perhaps *β*.

Aries the Ram is due east, and Taurus the Bull is rising below him. Andromeda, Perseus, and Auriga the Charioteer extend northeast from Pegasus. Cassiopeia, Cepheus, and Cygnus the Swan, which are all high up almost overhead, complete our brief survey.

THE PLANETS.

Mercury is evening star all through the month. He is best visible about the time of his greatest elongation on the 23d, when he sets about 6 P. M. and may be seen in the twilight.

Venus is also an evening star, but is too near the sun to be well seen.

Mars moves from Sagittarius into Capricornus during the month. He is conspicuous in the southwest in the early evening, remaining in sight until between 10 and 11 o'clock.

Jupiter is in Gemini, rising about midnight on the 15th.

Saturn is well visible, being just past opposition, and coming to the meridian at 11 P. M. at the beginning and 9 P. M. at the end of the month. His rings are turned almost exactly edgewise to us, and the sun shines on the hidden side, so that only the thin edge is visible, and this only in the most powerful telescopes.

Uranus is in Sagittarius, and is in quadrature on the 2d, crossing the meridian at 6 P. M. Neptune is in Gemini, almost exactly opposite him in the heavens, and is in quadrature on the 7th, southing at 6 A. M.

THE MOON.

New moon occurs at 5 A. M. on the 7th, first quarter at 5 A. M. on the 14th, full moon at 4 A. M. on the 21st, and last quarter at 3 A. M. on the 29th. The moon is nearest us on the 14th, and remotest on the 28th. She is in conjunction with Jupiter on the 2d, Venus on the 7th, Mercury on the 8th, Uranus on the 13th, Mars on the 15th, Saturn on the 18th, Neptune on the 27th, and Jupiter again on the 29th. The conjunctions with Jupiter and Mars are rather close.

Princeton University Observatory.

The French National Congress of Interior Navigation was held at Bordeaux this year. The subjects which were discussed were those which specially bore upon the questions of river and canal development and operation, with their relation to commerce and industry, with especial reference to modern conditions and requirements. There were seven general divisions of the subjects treated at the Congress, and reports upon each of these were presented by specialists. The following are some of the subjects of the different reports: Condition of the navigable systems of the country, compared with those of other European states. Construction and operating methods in use in France at present, referring specially to methods of equalizing the streams or canals, dams, locks, and other constructions, hauling material, canal-boats, etc. Use of streams from an agricultural standpoint and for transport, hydraulic plants, etc. Competition of navigable ways and railroads. Institutions for the promotion of boat construction. Best use of capital in connection with interior navigation. The Congress was held from the 18th to the 21st of July.

Chemists have long tried to manufacture precious stones in their laboratories, but have only succeeded in producing one—the ruby—on a commercially paying basis. Within the last month artificial sapphires have been announced, and some of them have reached New York from Paris. Hydrofluoric acid has no effect on the new sapphires. The imitation, however, has a specific gravity considerably lower than that of the real sapphire, and is softer than it. Another difference is that, while the natural stone refracts different colors brilliantly from different surfaces, the imitations do this only slightly, or not at all.

Sapphires and rubies are the same in their constituents except as to coloring. Cobalt gives the red color to the artificial ruby, and the experimenters have been trying to get blue stones by using chrome. But the process which produced rubies has failed to yield sapphires. The foreign manufacturers have refused to say how the new imitations are made.

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THE FIRST BRITISH MILITARY AIRSHIP.

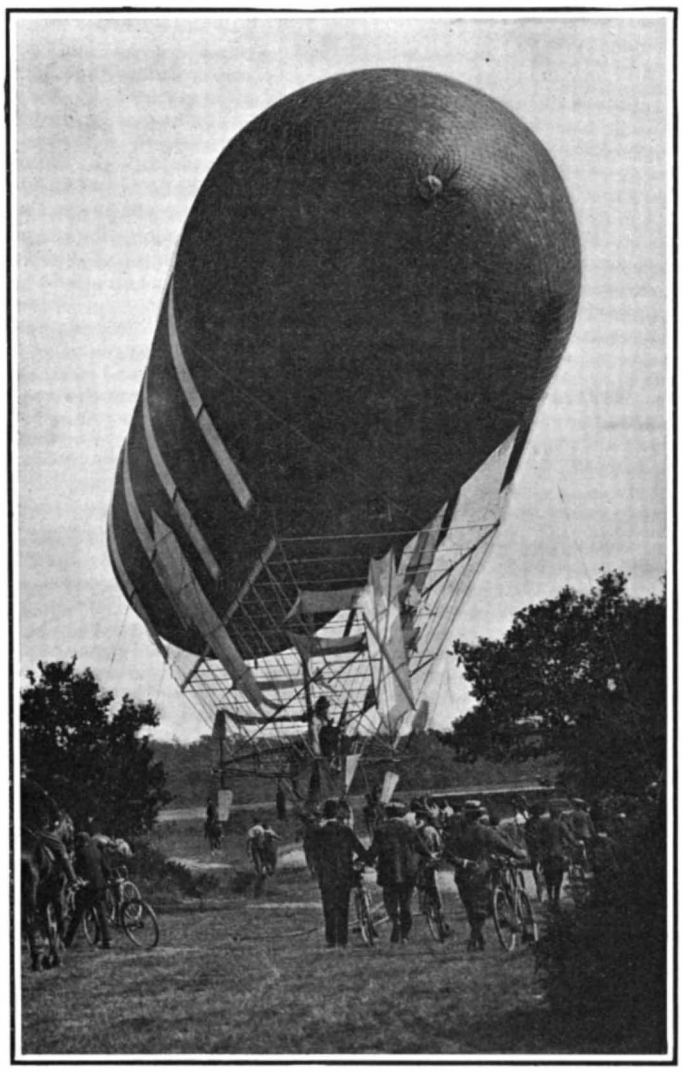
BY HAROLD J. SHEPSTONE.

Following the example of France and Germany, Great Britain has equipped her army with an airship. It is the first that the British government has constructed, and its recent successful flight will no doubt be the means of inducing the British War Office to build other aerial ships, and also to carry out experiments in that fascinating field—mechanical flight.

Naturally, the construction of the airship was kept a secret, and it was only a few days before this new dirigible was drawn out of its shed on Farnborough Common, near Aldershot, for its first flight, that the general public learned through the press that the British War Office had not only taken up the question of dirigible balloons, but had actually built one. It has been named the "Nulli Secundus," and compared to the airships of France and Germany, there is certainly some appropriateness in the title. Although the public was not aware that within a few miles of the military town of Aldershot an airship was nearing completion, the "Nulli Secundus" has been some six years on the stocks. No doubt, too, she would not have been completed to-day had it not been for the efforts and energy of the American, Col. S. F. Cody, well known as the inventor of man-lifting kites. Some months ago Col. Cody interested the British War Office in his kites, and he has been exclusively engaged by them ever since.

When he took up his quarters at Aldershot, he was shown the partially completed airship and the plans, and was asked to assist in its completion. When the writer inquired of this inventor what portion of the completed ship represented his handiwork, he replied: "I have certainly done some work upon it, particularly in connection with the framework, though I did not actually design it. I bought the engine for the government. I designed the engine-bed, the supports, and the devices for transmitting the power from the engine to the fore-shafts. In fact, I might add, the entire power-producing section of the airship is of my design, and a great deal of it was made at the forge, lathe, and bench with my own hands. I designed all the aeroplanes or wings by which the ship is steered." Although no official details of the airship have been given out, many interesting particulars have already been gleaned, while the photographs secured at the initial flight depict the leading characteristics of this, the first of Great Britain's aerial warships. The main gas-vessel resembles an enormous sausage, for it is cylindrical throughout, with the exception of the blunt semi-spherical ends. Over all it measures some 100 feet in length, while its diameter is about 30 feet, and its capacity for the hydrogen gas with which it is filled about 60,000 cubic feet. It is made of gold-beater's skin, and in addition to the netting, which at present covers the entire gas-vessel, there are at equal intervals four broad silk bands which pass round it. By means of these silk bands and netting, a secure fixing is obtained to an upper framing, that serves to support the rudder as well as the parts that lie below.

Suspended below the envelope there are in all three distinct horizontal frameworks; for at some little distance below that already referred to, is an intermediate elliptical grid made of tubing, which is held in place by a comparatively few diagonal and straight stays, of a much more substantial character than those which connect the envelope with the upper framing, while the car proper is hung some few feet still lower. By this means a very rigid structure is provided, which occupies some thirty feet between the envelope and the car. The rudder, which is of large size, projects out behind this framework, and the space between the upper and the intermediate framings is utilized for fixing a pair of superimposed canvas aeroplanes both fore and aft. A strong metal framework with a steel keel forms the car, this having been given the shape and general appearance of a canoe by the canvas covering with which it is incased. Some 30 feet long by 2 feet 6 inches deep, it hangs centrally beneath the huge envelope, while forming part of its framework is a long girder of tubular construction above the gunwale, placed transversely to project on either side. It is this transverse girder which supports the two propellers by which the ship is propelled, and these propellers are driven from the motor by long belts running over

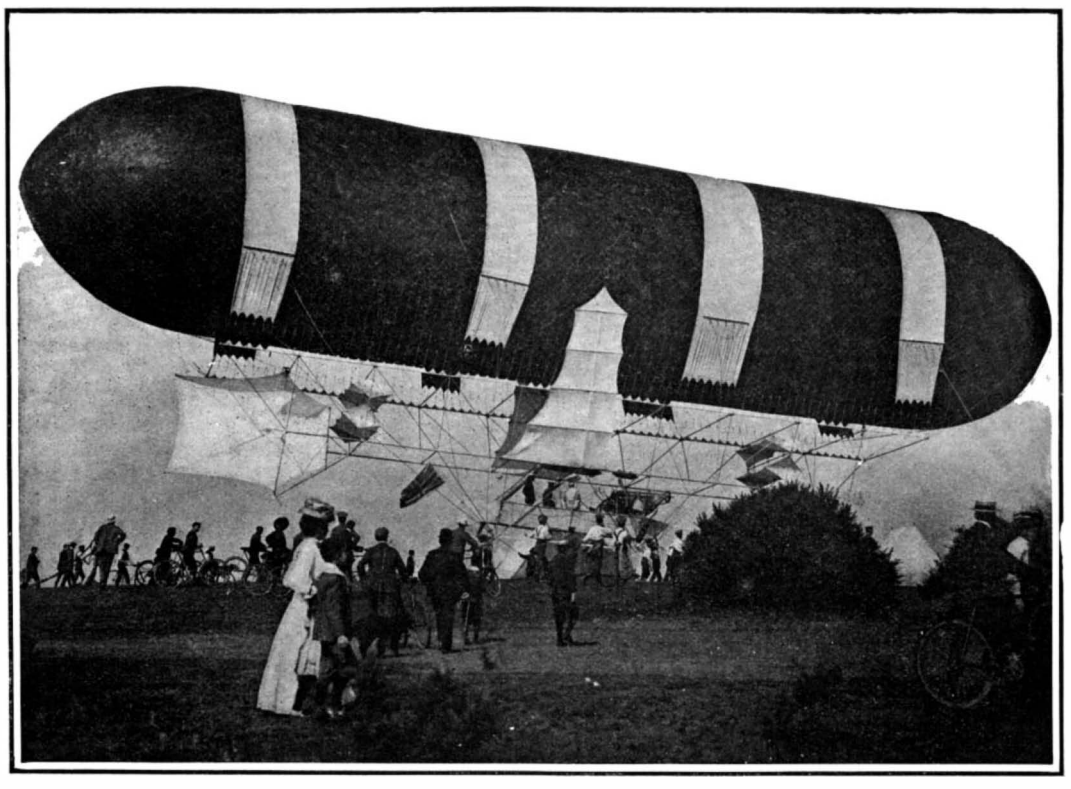


END VIEW OF THE AIRSHIP, SHOWING THE PROPELLERS, RUDDER AND VANES.

wire-spoked pulley wheels. As will be gathered from our illustrations, the motor is fixed high above the forward portion of the "canoe," with a regular automobile radiator immediately in front of it, and with its wire-spoked flywheel on the rear end of the crank-shaft. The flywheel, therefore, lies practically across the center of the car, leaving the entire aft half of the "canoe" available for the three occupants. The propellers are no less than 10 feet in diameter, and that is why the transverse framing which supports them is of as great a length as it is seen to be in one of the accompanying views. Each propeller has two blades, and is of very light construction. The engine is of the eight-cylinder V type, capable of developing over 50 horse-power, and its fuel tanks, which are torpedo shaped, are secured above on the intermediate framework already referred to. The two main exhaust pipes project downwardly and rearwardly, one on each side, looking, with the silencers in which they terminate, like huge antennæ.

From the envelope, the large filler tube is brought down to the stern of the car, and special arrangements—including certain automatic devices—are made both for regulating the pressure in the envelope to suit requirements, and also for automatically preventing it from rising unduly at any time. Auxiliary wings and aeroplanes are, moreover, features of great importance to the control of the ship, for not only have two large wings been fitted, one on either side—presumably to act to some extent as horizontal rudders—but other aeroplanes are, as already mentioned, arranged between the two upper frames. These side wings are hinged, so that they can be let down into a horizontal position when aloft, but can be swung up into the position shown in our illustrations when the ship is near the ground. As a matter of fact, these wings were removed during the second flight of the ship, but were carried and tested on the ship's first ascent.

On its initial flights—for the airship made two distinct ascents on the day it was first taken from its shed—it carried three passengers. On the first journey it took aloft Col. Capper, who took the wheel; Col. Cody, who looked after the machinery; and Capt. W. A. King. The great dirigible balloon rose slowly until it reached a height of 150 feet, when the vessel was stopped by the ropes which held it. Seeing that everything was all right, Col. Capper shouted through the megaphone "Let go!" and the ship sailed away, for the first time in its life free from all connection with Mother Earth. Rising to a height of some 400 feet, it made a straight course of about half a mile and then made a complete sweep, all the while maneuvering about apparently under perfect control. After having been aloft for some twelve minutes, the driving belt of the fan broke, and although a small matter, which could have been rectified on the spot, it was considered desirable to descend. The airship descended safely, and was taken back to its shed. A few hours later it was again brought out in the sunshine, and the second flight was accomplished, the passengers being Col. Capper, Col. Cody, and Mr. McWade. This ascent quickly came to an end, however. The ship had hardly reached a height of 200 feet when an attempt was made to turn her suddenly. Almost instantly the ship turned its nose downward, and with great swiftness shot obliquely toward the earth. The spectators, fearful of the consequences, were greatly alarmed, but the ship, though hitting the ground hard, rebounded, which lessened the blow. The only damage done was the bending of some of the framework. This brought the trials to an end, and, all things considered, the ascents were most satisfactory.



THE FIRST BRITISH MILITARY AIRSHIP "NULLI SECUNDUS."

Length, 100 feet; diameter, 30 feet; hydrogen capacity, 60,000 cubic feet.

Seen after the last ascent Col. Cody declared that the "Nulli Secundus" showed her capability of traveling from 12 to 15 miles an hour in a dead calm. "When some improvements are made," he declared, "we shall be able to do 25 miles and perhaps 30 miles an hour. Of course, if the ship is navigated against the wind, the velocity of the wind must be deducted, and if the ship goes with the wind the speed is still further increased. For instance, if the ship went 25 miles an hour, she would actually travel 40 miles, if she followed in a 15-mile an hour wind."

Undoubtedly the British airship compares very favorably with those possessed by the French and German armies, each of which possesses two military dirigibles at the present time. France has the "Lebaudy," built in 1905, and "La Patrie," built in 1906. The latter, in July last, accomplished a remarkable and sensational flight directly over Paris. It answered the helm easily, and traveled at a speed of 18 miles an hour against the wind. This airship is driven by means of two lateral propellers actuated by a 75-horse-power Panhard motor. The car is so made

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as to facilitate packing and transport by rail. This airship cost $60,000 to build.

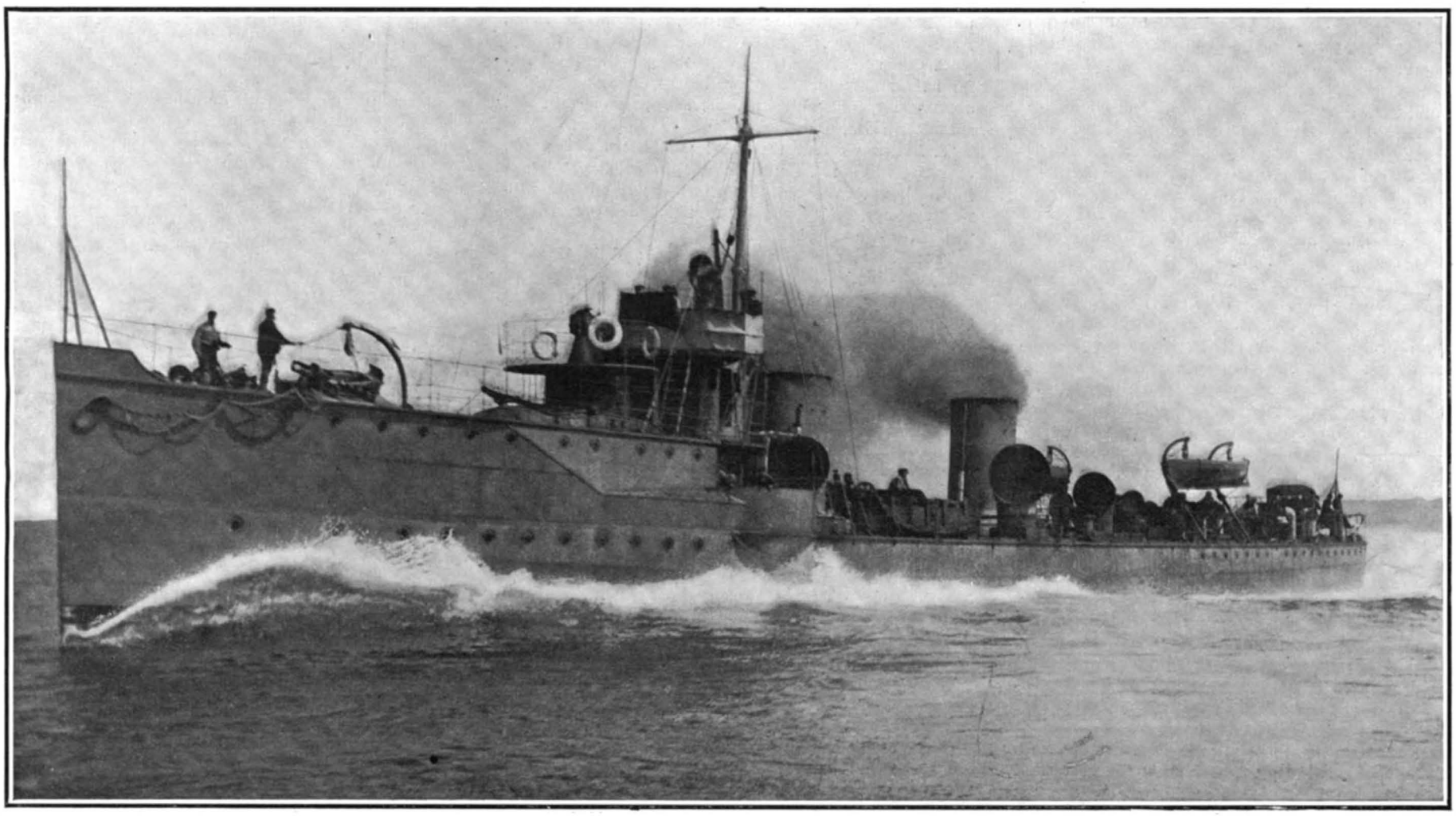
Germany also has had successful results with the Parseval and Gross airships, and the Germans are now about to build another huge airship of the Zeppelin type.

SEA-GOING TORPEDO BOATS.

The accompanying illustration of the torpedo-boat destroyer "Eden" should attract attention because it represents the latest evidence of a decided trend in the development of torpedo boats toward a vessel of considerable displacement and freeboard with ability to keep the seas in all weathers. The "Eden" is one of thirty-four sister vessels launched for the British government between 1903 and 1905. As a class, they are from 220 to 225 feet in length, 23½ feet beam, and draw 10 feet of water. There are slight variations among the thirty-four vessels as to dimensions and general particulars, the "Eden" being 220 feet long, 23 feet beam, and 8¾ feet draft. She is driven by Parsons turbines, operating six propellers, and with 7,000 horse-power her mean speed is 25½ knots an hour. She carries one 12-pounder gun forward and five 6-pounders aft and in broadside. She has two torpedo tubes, a coal capacity of 130 tons, and a complement of seventy officers and men.

Now in the "Eden" class of boats, the high speed of the preceding class of seventy 30-knot boats, built between 1896 and 1902 for the British navy, has been sacrificed in favor of seaworthiness, comfort, and coal capacity. The 30-knot boats were about 10 feet shorter, of from 2 to 3 feet less beam, and about 4 feet less draft, and their displacement was 300 tons as compared with the 550 tons displacement of the "Eden" class. From our illustration it will be seen that the "Eden" carries a high forecastle deck, which extends aft to the conning tower, and it is upon this deck that the 12-pounder gun is mounted. She has a rather lofty bridge, a single signal mast, and two low funnels of large diameter. The other vessels of the class are generally similar in design, the main difference being that fifteen of the boats are provided with four funnels instead of two.

In the later ships, authorized from 1905 to 1906, the tendency to increase the displacement is even more marked, but at the same time there is a return to the high speed of the boats of the 1896 to 1902 period. Under this programme there are now being built five ocean-going turbine-driven torpedo boats of 600 tons displacement and 33 knots speed, and one turbine-driven ocean-going torpedo boat of 800 tons displacement, 30,000 horse-power, and 36 knots speed.



A MODERN TYPE OF TORPEDO CRAFT, THE BRITISH SEA-GOING DESTROYER "EDEN."

The Amount of Energy Consumed in Speaking.

BY DR. ALFRED GRADENWITZ.

An orator, when speaking in a hall, the acoustic qualities of which are unknown to him, is often uncertain as to the energy to be evolved in order to make himself heard by all his auditors. In fact, this problem is of a rather complicated nature, there being three factors to be taken into account, namely, the hall itself, the auditors, and the speaker.

As regards the influence of the hall, Dr. Marage, of Paris, by the aid of his talking siren described in these columns,* has ascertained that this will be satisfactory if there is no echo, and if the sound of resonance is of a duration sufficient to reinforce the original sound without interfering with the one following.

As to the auditors, the sense of hearing obviously is not developed with the same sharpness in all of them, while their actual physiological condition is likewise of some importance.

As regards finally the orator himself, it is a known fact that certain voices are more far-reaching than others. The significance of this fact has not so far been known, and has been first elucidated by Dr. Marage, who, by the aid of his siren, has determined the energy required in order to be heard, by an orator, according as the latter has a bass, baritone, or tenor voice.

As the energy of the sound is given by the product VH of the volume V of air escaping from the lungs of the orator by the pressure H to which the latter is subjected, these two quantities have to be determined. Now, as in an ordinary orator an accurate measurement is impracticable, Dr. Marage replaces the speaker by an artificial orator, his talking siren.

By extensive experiments on acoustic sensitiveness, Dr. Marage has shown that the synthetical vowels OU, O, and A (or their English equivalents OO, O, and A, as in father) when given out on the same note, F, for instance, which is shared by bass, baritone, and tenor voices, will produce the same impression on the ear of an auditor as a bass, baritone, or tenor voice respectively; it will thus be sufficient successively to produce these three vowels, ascertaining the minimum amount of energy required for making one of these sounds perceptible to an auditor placed at the different points of a hall.

The results found by Marage are recorded in the following table, the average of six experiments being given for each of four halls, and the energy of the sound being the amount of kilogramme-meters per second:

Halls.	Bass.	Baritone.	Tenor.
Trocadero	0.0014	0.00012	0.000088
Sorbonne Church	0.00089	0.00012	0.000088
Academy of Medicine.....	0.00026	0.00009	0.000030
Richelieu Amphitheater ..	0.00015	0.000051	0.000021

As inferred from this table, a bass voice is under a decided disadvantage, having to spend an amount of energy seven to sixteen times greater than a tenor. Baritone voices, while being intermediary between the bass and the tenor, are found to approach nearer the latter. As regards the various halls, a tenor has to give out four times more energy in the Trocadero than in the Richelieu Amphitheater, while a bass voice, according to the hall, has sometimes to spend an energy nine times greater.

The energy to be evolved by the orator obviously depends on the situation of the auditors, the amount of energy to be spent by a bass in order to be perceptible to the worst located auditors at the Trocadero being, for instance, 0.004, while an energy of 0.0003, that is to say thirteen times less, will be sufficient for the first rows. However, these difficulties are partly compensated for by the fact that those auditors whose sense of hearing is inferior to the normal generally prefer the first rows.

As a practical rule, it may be said that in order to be heard in an unknown hall, the energy of the voice should be gradually augmented, till the orator himself begins to perceive the sound of resonance; if the energy be then reduced to some extent, the best possible results will be obtained.

Dr. Marage has later been able to experiment on two human subjects, one of whom had undergone a larynx amputation, his trachea communicating through a flexible tube with a caoutchouc membrane fixed in the mouth to an artificial glottis. This tube was branched in such a way as to allow the pressure to be determined by means of a metallic manometer. The output of air and the number and duration of inspirations were measured in the ordinary manner.

The other subject had normal vocal chords and a tracheal canula. The latter being made to communicate with a manometer, would give constantly the pressure H of the air evolved during the talking process.

Some of the main results obtained by Dr. Marage are recorded in the following:

The air pressure, both in a natural and artificial larynx, will vary between 100 and 200 millimeters; in enunciating the simple phrase, "bonjour, monsieur," the manometer will oscillate between 120 and 160.

As the vocal chords are of different lengths in men (20 to 24 millimeters) and women (16 to 18 millimeters) respectively, experiments were made in which the length of the vibrating portion of the membrane was gradually altered.

In the case of a length of 24 millimeters, the minimum energy required for causing these artificial vocal chords to vibrate was found to be 57 kilogramme-meters per hour, while in that of short membranes (18 millimeters) 14.4 kilogramme-meters was found to be sufficient.

This accounts for the fact that women generally are tired far less by talking than men, and that children are able to talk the whole day without the least apparent fatigue.

* SCIENTIFIC AMERICAN, Vol. xcvi, No. 19.

The North German Lloyd Steamship Company contradict the report that they intend building a boat several knots faster than the "Lusitania." Such a speed is impracticable in steamships, and moreover, the company has sufficient boats for present requirements.

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Transportation in Germany.

We are so accustomed to the phrase "the Germans are the greatest commercial nation in the world," that we accept it with little or no hesitation. It is seldom even that we stop to give thought to the many factors entering into this superiority, or to consider in what particular phase German industrial conditions differ from ours. In fact, so far as physical conditions are concerned, Germany—the term is used in its larger colloquial sense—is no better off than is the United States. The manufacturing districts are nearly all situated at distances, greater or less, from the coast, and whether dependent upon the "Hinterland" or upon foreign countries for crude materials, are under the disadvantage of an initial transportation charge. Their available mineral deposits are, perhaps, somewhat more difficult to work than ours, so that in the main, their principal advantages are cheap carrying facilities over inland waterways and by rail. The importance that transportation plays can be seen from the fact that many manufactures that are stifling similar foreign industries by successful competition, would themselves be destroyed if an increase of 1/25 of a cent per ton-mile were made in freight charges.

Germany's policy with regard to transportation is markedly set forth in the following paragraphs from an official organ:

"Any means whereby the distances which separate the economic centers of the country from one another can be diminished, must be welcomed and be considered as a progress, for it increases our strength in our industrial competition with foreign countries. Every one who desires to send or to receive goods wishes for cheap freights. Hence the aim of a healthy transport policy should be to diminish as far as possible the economically unproductive costs of transport. A country such as Germany, which is fortunate enough to produce on its own soil by far the larger part of the raw material and food which it requires, occupies the most independent and the most favorable position if, owing to cheap inland transportation, its economic centers are placed as poorly as possible to one another. When this has been achieved, Germany will be able to dispense with many foreign products, and it will occupy a position of superiority in comparison with all those states which do not possess similarly perfect means of transport.

"Many circumstances which in former times gave superiority to certain countries, such as the greater skill of their workmen, superior machinery, cheaper wages, greater natural fertility of the soil; all these advantages are gradually being leveled down by time and progress. But what will remain is the advantage of a well-planned system of transportation, which makes the best possible use of local resources and local advantages. It is to this that England owes to a large extent her unique position for commercial exchange with other countries."

Such principles have taken practical form in the one hundred and fifty million dollars that have been spent on waterways alone in the last twenty years. Moreover, these waterways are not mere ditches, on which even antiquated barges have scant room to move, but spacious routes on which, in the year 1902, the ships of 300 tons and over numbered 4,633. Although the original expense of such canals is much greater than that of those allowing the use of smaller boats only, the following figures show the decrease in freight cost as the size of the vessel increases:

Cost of Transportation per Ton per Kilometer on Canals, in Ships of Various Sizes, During a Ten Months' Shipping Season.

150	200	300	400	450	600	1,000	1,500 Tons.
0.79	0.63	0.48	0.41	0.38	0.30	0.23	0.21 Pfg.

When it is considered that the pfennig is about one-fourth of a cent, and that the kilometer is equal to 0.62 of a mile, the remarkable saving made by this class of carrier is evident.

Through the steps taken to improve the navigable channel of the Rhine alone, the weight of goods passing through Emmerich on the German-Dutch frontier has increased nearly 300 per cent during fourteen years. The actual figures are given in the following table:

	Upstream. Tons.	Downstream. Tons.
1889	2,799,800	2,593,000
1894	4,771,500	3,142,000
1897	6,929,100	3,480,200
1900	9,036,400	4,129,700
1903	10,027,900	7,211,900

With regard to the railroads, the sentiment is the same as it is concerning canals. Germany was very late in adopting this form of transportation; indeed it was not until 1835 that her first line, four miles in length, was opened. Notwithstanding the fact tha railroads and the principles governing them were imported from England in bulk, so to speak, where everything was opposed to government interference in 1838, the year that her first railroad was opened, Prussia passed a most wise and far-seeing law. It gave to individuals great freedom in building lines, but reserved to the state power which insured an adequate control over them. This law further granted to the government the privilege of taking over private systems after thirty years, at an extremely fair valuation based on the outlay of capital, and that fares and freight rates should be reduced proportionately whenever the net profits of any road should exceed 10 per cent on the capital actually invested. It was a long time, however, before the privilege of purchase was taken advantage of with activity.

Up to the year 1879, Germany had no definite railroad policy. In that year, both protection and the state ownership of railroads were introduced, owing, perhaps, to Bismarck's having, in 1876, paved the way for them by the following opinion and statement, as well as by a host of others:

"Railways were meant to be, and are, instruments for conveying the national traffic, and they were given their far-reaching privileges and they were constructed in order to serve the public and general interest. Therefore their character as profit-earning instruments may be taken into consideration only in so far as that character is compatible with the general welfare, which has to be considered first and foremost. Hence the right of constructing and exploiting railways can be considered only as temporary, and their eventual purchase by the government is a matter of course.

"The disadvantages of private ownership are:

"1. Unnecessarily high working expenses and correspondingly high charges in consequence of the multiplicity of railway boards, managers, offices, and the unnecessary duplication of lines, stations, material, rolling stock, etc.

"2. Chaos of freight charges, there being 1,400 different tariffs which are constantly changing, which are unclear, and which make trade an uncertain and speculative venture.

"3. Because direct travel of passengers and goods over the whole railway system of the country is often impeded, with the object of harming competing railway systems, and consequently much damage is done to the trade and industry."

These shots opened the campaign, and in 1879, as has just been mentioned, the system of German state railroads became a fact. Under this system, fares and rates are not fixed to obtain the greatest profit for the system, but rather to do the greatest amount of good to the shipper, whether large or small. The freight rates are so simple to compute, that any one even of the lowest intelligence can figure the cost of transportation between any two points.

The great argument against government ownership, that the state, as a monopoly, is unprogressive, does not hold in Germany; for in the twenty-two years from 1880 to 1902, the mileage of the government roads increased 55.5 per cent. The profits earned by the Prussian roads, in spite of a general increase in running expenses and a decrease in freight and passenger charges, have been as follows, showing an increase since 1879, when they came under government management:

	Per cent.
1869	6.5
1874	4.4
1879	4.9
1884-5	4.9
1889-90	6.2
1894-5	5.6
1900	7.0

Prussia borrowed the money with which she bought her railroads at about 3½ per cent, so that each year an immense profit flows into her exchequer. In 1903 this income was sufficient to pay not only the interest on the state debt of $1,756,677,500, but to provide for its redemption, leaving in addition a clear balance of some $50,000,000 for the relief of taxation.

These facts and figures seem to point to government ownership as a cure for many abuses; but it is a question if any other country could have placed it upon so satisfactory a basis—a thing which was made possible in Germany by the form of government and by the peculiar national temperament.

Successful Flight of the Zeppelin Airship.

It is nearly a year since Count Von Zeppelin's huge airship—the largest in the world—made the first successful demonstration of its high-speed capability by maintaining itself stationary against a wind of 33½ miles an hour. This gigantic airship was fully illustrated and described in the Scientific American of December 22, 1906. The gas-containing envelope is built around a rigid framework and is divided into six compartments. There are two cars, each of which contains a 35-horse-power gasoline engine, driving propellers.

The airship has been remodeled and improved of late. It now has a length of 420 feet, a diameter of 38 feet, and a capacity of 11,000 cubic meters (388,465 cubic feet). Its total lifting capacity is several tons. The steering arrangements have been perfected, so that the airship can now turn in a circle about three-fourths of a mile in length, and can rise or descend with ease according as it is steered by the helmsman. Improvements in the shape of and high light and of Telefunken wireless telegraphy instruments have also been added. Count Von Zeppelin announced that he would make a long-distance flight from Manzell, on the shore of Lake Constance, to Berlin, on the 24th ultimo; and although he did not do this, he did, however, make a splendid demonstration of his airship, both as regards its speed and controllability.

On the date mentioned, the airship emerged from its floating shed (which is arranged on pontoons, so that it can be pointed directly into the wind) and made a complete circuit of the lake, passing over five different states, and easily beating all the water craft. Its speed at times is said to have reached 38 miles an hour. The airship made numerous sharp turns, and performed difficult evolutions in front of the royal castle at Friedrichshafen. At times it would almost dip into the lake, and then again it would rise to a height of 600 feet or more. During its flight it passed over the towns of Rorschash, Bregenz, Lindau, and Friedrichshafen. The flight lasted four and a quarter hours. In making it the new airship showed itself the equal of the Wright aeroplane as far as speed is concerned, while its adaptability to commercial use would seem to be greater. No less than seven men were on board during the flight.

The New York Electrical Show.

The Electrical Show which opened in Madison Square Garden, New York, on September 30 will remain open until October 9. Among the exhibitors are New York Edison, Brooklyn Edison, General Electric, Marconi Wireless, Westinghouse, Western Union Telegraph, Postal Telegraph, Monahan Construction, National Lamp, Telharmonic Music, Standard Roller Bearing, Telelectric Music Companies, Electrical Testing Laboratories, Chas. Gest, New York Beck Lamp, Mogul Paint, Dixon Harris Wire, Safety Car Heating and Lighting, India Rubber and Gutta Percha, Federal Sign, National Dairy Supply, Hydrant Zinc, Thomas Prosser, F. Alexander, Standard Wire Brush, and a host of other companies. Among the features, those catering to public interest will of course be in evidence. They will include cooking and milking by electricity, electrical music, electrical printing of souvenirs, etc., and contests for visitors.

The Eastward-Bound Trip of the "Lusitania."

The "Lusitania" made her first eastward voyage in 5 days, 4 hours, 19 minutes, having maintained an average speed of 22¾ knots throughout the voyage. This time is 3 hours 25 minutes longer than that of the western trip, but the boat took a longer course on her return. The previous "best" between New York and Queenstown was made by the "Lucania" in 5 days, 8 hours, 38 minutes. Those enthusiasts who have been looking for a record-breaking trip on this first eastward voyage have been doomed to disappointment. It may be months before the vessel makes her best showing, on some occasion when everything in sea, wind, and boat is favorable. On her first outward, and still more on her homeward voyage, the great boat encountered slight mists, which necessitated a lowering of speed.

New York Street Railway Casualties.

The New York local street railways report 5,500 accidents, including 42 fatal ones, in connection with their lines between August 5 and August 31 of this year; 4,859, or almost ninety per cent of these, were accidents to the public, the remaining 641 being employees of the company. Four hundred and five persons were struck by cars, and 610 were injured by collisions either between cars or between cars and vehicles. Nineteen hundred and four injuries were caused by boarding or alighting from cars. The report was furnished under an order from the Public Service Commission.

On September 21 a thunderstorm which passed over New York left an unusual number of traces behind it. Among other damage, a large section of the superstructure of the eastern end of the Blackwell's Island Bridge was knocked to pieces, the heavy timbers falling to the ground. A bolt of lightning struck the 175-foot section and so weakened it that two or three heavy gusts of wind brought the whole piece smashing to the ground. All the workmen had gone for the day, and two watchmen, who were in a little shanty that was smashed by the falling timbers, were not injured. A big derrick at the eastern end of the section was also toppled over. The accident will cost the Buckley Construction Company some $20,000 and will delay that section of the bridge for several weeks.

It is said that Harland & Wolff, of Belfast, and John Brown, of Glasgow, are to build and equip a steamship for the Hamburg-American company larger than the "Lusitania." It is to be fitted with a combination of reciprocating and turbine engines.

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Correspondence.

Recovery of Nitrate of Soda.

To the Editor of the SCIENTIFIC AMERICAN:

It is pretty generally known that nitrate of soda is one of the most profitable by-products of gas making. There are about 90 pounds in each ton of coal. The value of this at 12 shillings per hundredweight is equal to 10 shillings per ton of coal, so coal costing 1ɜ shillings per ton would mean a saving of about three-fourths in price.

Several years ago I had a correspondence with Messrs. Brumer, Mond & Co., of England, who are patentees of a process for recovering nitrate from coal while utilizing the latter into gas for manufacturing purposes (excluding lighting).

I wanted to have a license for using their process, but they informed me their process was only suitable for 250 tons per week or upward. At my works our consumption is about 25 tons per week for steam raising.

Can any of your readers tell me of a plant that would recover the ammonia from this quantity of coal?

Fern Bank, Knock, Belfast. GEORGE WALKER.

A Flying Machine Suggestion.

To the Editor of the SCIENTIFIC AMERICAN:

I have read with interest your accounts of various experiments with flying machines, and have been surprised at the antiquated ideas held by many investigators. I believe we will succeed in the conquest of the air, but not by any form of gas-bag, motor-propelled, nor by copying nature in imitation of birds soaring or flying. Success in navigating the ocean was not attained by making a huge duck, propelled by means of two great webbed feet; nor did locomotion on land come by steam men or steam horses. In each instance nature was ignored and new ideas and devices were introduced, with the result that the swiftest animal is outdistanced by the locomotive, or even by the motor-cycle with its tiny gasoline engine.

The aeroplane is a long step in advance of the dirigible balloon, but it suffers two disadvantages —the necessity for high speed in starting and maintaining flight, and the great risk in alighting. I consider the gyroscope the most promising form of machine to which attention can be given. Is not a gyroscope a number of gliding planes arranged in a circle? In revolving a horizontal fan are not a number of small planes set in motion, and will not their pressure in forcing the air downward be just as effective as if they were driven forward in a straight line?

Any heavier-than-air machine must raise itself by forcing the air downward, and the most effective way will prove to be by the horizontal fan or gyroscope. If a single fan were operated from the center of the car, the moment the car left the ground it would spin in the direction opposite to the propeller. Two propellers have been tried, one above the other, driven in opposite directions. Unfortunately the lower propeller works in the current of air driven downward from the upper one, and so is very inefficient.

In the accompanying sketch I give a suggestion of two propellers, one at each end of a walking beam or whiffletree arrangement, with the car swung pivotally from the center of the beam like a pendulum.

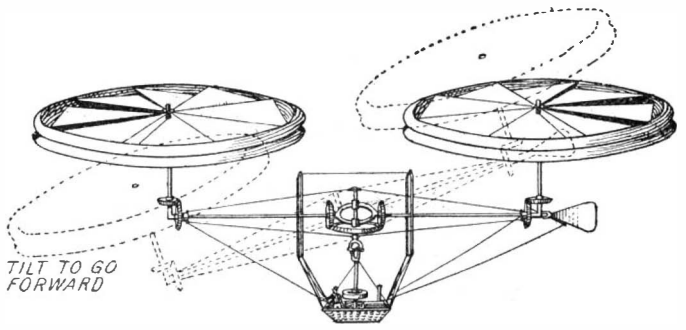
If a propeller were attached to a mast at each end of a long car, it would be difficult to distribute the weight and adjust the lifting power, and the machine would turn turtle. But with the car swung like a pendulum from the center of the beam, balance could be maintained by automatic devices to control propeller speeds.

In using fans as lifting devices the air is forced downward, but a large percentage is thrown off horizontally by centrifugal force, and so wasted. If two bands, one above the other, encircled each fan and curved downward, the air escaping to the sides would be deflected downward, and so in part check this waste.

If my ideas will help toward the solution of the aerial navigation problem, they are entirely at the disposal of any workers along that line.

Toronto, Ont., June 10, 1907. A. C. LAWRENCE.

[Our correspondent advances ideas that are generally supposed to be correct, but that are disproved by experiment. His notion that when two propellers of a helicopter are superposed and revolved in opposite directions, the thrust of the lower one is seriously interfered with by the downward draft from the one above, has been disproved time and again in practice. Secondly, his idea of placing rims upon his propellers to keep the air from being thrown off by centrifugal force is not based upon the facts, for by holding a handkerchief or strip of paper beside a rapidly-revolving fan, it can be readily seen that an indraft of air toward the center of the fan is produced near the tips of the blades, instead of the air being thrown out by centrifugal force. Experiment shows, moreover, that a fan having a multiplicity of blades encircled by a rim is not as efficient as an ordinary two-bladed propeller. The idea of having two propellers attached to a walking-beam seems, however, to be novel.—ED.]



A FLYING MACHINE SUGGESTION.

Moving Platforms on the Brooklyn Bridge.

To the Editor of the SCIENTIFIC AMERICAN:

Referring to the interesting article entitled "Moving Platforms for the Brooklyn Bridge," which appeared in the SCIENTIFIC AMERICAN of September 21, I respectfully ask space to say a few words in reply to your remark that one very strong argument against the substitution of platforms for car service will be found in the fact that it would prevent the future institution of through car service, either by trolleys or elevated cars, between Brooklyn and Manhattan. This is not quite correct. It is not intended to occupy the entire present track space of the Brooklyn Bridge for the continuous transit, or moving platforms, but only the space occupied by the elevated trains. The trolley lines could therefore enter Manhattan in addition to the moving platforms, and carry out the through traffic idea as far as it is possible on that bridge. After the bridge is constructed and more track space is obtained, the same idea could be applied to the elevated roads. The facts in the case are that the Brooklyn Bridge had originally only two tracks, and was not built or intended for through traffic. Through traffic should expand fanlike at the terminals, and at the Manhattan terminal of the Brooklyn Bridge such fanlike expansion is impracticable, if not impossible. The Williamsburg Bridge, and the two other bridges now under construction, do not meet with this difficulty, and through traffic can expand at the terminals of these bridges, as contemplated when they were designed.

As to the Brooklyn Bridge, the moving platform plan would make away at one stroke with practically all the objectionable features which combine to make the problem so hard to solve. Thus: The congestion of passengers, the switching of trains, the "packed-car" unit, the inability of more than thirty per cent of the passengers to find seats, the waiting for trains, the collisions between trains, and the dangers and traffic blockades resulting therefrom and connected therewith—all these objections are instantly removed. Incidentally, a reconstruction of the bridge (unless desired at a later period for elevated through traffic, as already stated) would become unnecessary, for the reason that with a moving platform equipment the loads on the bridge and the stress on the bridge members would be uniform, and not oscillating as at present.

Considering the gravity of the problem, and the necessity of solving it at the earliest possible moment, we have recently urged upon the Public Service Commission the appointment of a board of disinterested technical men, to consider the various plans that have been submitted, with a view of reporting upon a plan which the Public Service Commission may safely recommend to the Board of Estimate. We believe that the responsibility which the Public Service Commission would assume in making any recommendation would be considerably lessened, if such a recommendation would have the support of a board of technical men, disinterested and unprejudiced, such as we have suggested.

MAX E. SCHMIDT,
President and Chief Engineer of the Continuous Transit Securities Company.

New York, September 24, 1907.

The Current Supplement.

Though the English county of Cornwall is primarily dependent for its prosperity upon the mining of tin, yet within the last few decades it has attained a preeminent position in the supply of arsenic. In the opening article of the current SUPPLEMENT, No. 1657, the English correspondent of the SCIENTIFIC AMERICAN describes the industry and the manner in which the metal is mined and refined. Dr. Theodor Koller writes instructively on the utilization of the residual products of brewing. A device for automatically controlling the heating of a house is described and illustrated. In an article entitled "The Design of Induction Coils," the authors, William O. Eddy and Melville Eastham, enumerate and discuss the various factors that should be considered by the maker or designer of effective and efficient induction coils, without allowing theoretical considerations to outweigh manufacturing difficulties and the cost of construction. The object intended is to present the theory relating to the essential component parts of a coil and their mutual relations, as well as facts learned from experience in the building of induction coils. Prof. Silvanus P. Thompson contributes a thoughtful article on the interaction of abstract science and its applications. Until recently the metal tantalum was almost unknown to the greater number of chemists, and was considered a laboratory substance. Since industrial needs led to the use of the refractory properties of tantalum, mines of tantalum ore have been discovered and worked. The metal, which was once extremely rare and costly, and is now valued less than silver, is ably discussed. Cable-assisted trains on a Scotch railroad are described in an illustrated article. An abstract of Sir William Ramsay's British Association address on the variability in the products resulting from changes in radium emanation is discussed. The Lumière single-plate photographic color process is again made the subject of an article. This time formulas are given which the English reader can understand and use. G. H. Morrison contributes another installment of his interesting treatise on the development of armored war vessels. In the present installment rams are treated. The cult of the cactus is the subject of an excellent article, admirably illustrated, by S. Leonard Bastin. The soil of the United States constitutes the one great inexhaustible natural resource of the country. For that reason a paper by J. A. Bonsteel on the use and value of soil surveys should be read with interest. At the last meeting of the American Association for the Advancement of Science, Prof. William North Rice read a paper on the tertiary mammals and the doctrine of evolution. A liberal abstract of the paper is published. The progress of the new incandescent lamps is summarized.

The Mikkelsen Arctic Expedition.

The report that Capt. Mikkelsen had been lost during an over-ice sledge dash to the north of Alaska has happily proved false. One of the objects of his search was to find supposed land to the north of Alaska, but in this he has been unsuccessful.

Capt. Mikkelsen, who is a Dane, left Vancouver, B. C., in the "Duchess of Bedford," the ship belonging to the Anglo-American expedition, early last year. The ship has been lost or very badly damaged, but the expedition will continue its work of exploring Beaufort Sea, surveying the coast and making geological and ethnographical studies.

It was Capt. Mikkelsen's plan to sail his ship into Bering Sea about August, and thence to sail down the Alaskan coast and establish a station on the west coast of British Columbia, for the coming winter. This summer, according to the plans, the "Duchess of Bedford" was to proceed back through Bering Strait up the Siberian coast and leave the party with 140 days' provisions to march west-northwest in search of new land and to make soundings through ice cracks to ascertain the configuration of the sea's bottom.

That the expedition encountered many difficulties, being delayed in its voyage eastward from Bering Strait, and that Capt. Mikkelsen virtually abandoned hope of reaching the proposed winter quarters before being frozen in by the ice, are pretty near certain.

His plans, however, provided for a stay in the North of several years if necessary, and probably he will remain and winter there.

Death of Prof. W. O. Atwater.

Prof. Wilbur O. Atwater, head of the department of chemistry at Wesleyan University, Middletown, Conn., died on September 22 after an illness of two years.

Prof. Atwater was born in New York State in 1844, and was graduated from Wesleyan in 1865. He received his doctor's degree from Yale in 1869, and afterward studied at Leipsic and Berlin. He was professor of chemistry at East Tennessee University and at the Maine State College before he came to Wesleyan. Prof. Atwater was director of the Office of Experiment Stations in the United States Department of Agriculture from 1888 to 1891. Since 1894 he had charge of the nutrition investigations of the United States Department of Agriculture, and in conjunction with Prof. Rosa, of the Bureau of Weights and Measures, he invented the Atwater-Rosa calorimeter, for experiments on the metabolic changes going on in the human body.

His work in proof of the food value of alcohol caused much discussion. Dr. Atwater was the author of numerous articles on physiological and agricultural chemistry.

It is said that Japan has ordered a battleship of 18,000 tons to be built in Scotland. The feature of her construction will be her great width of beam.

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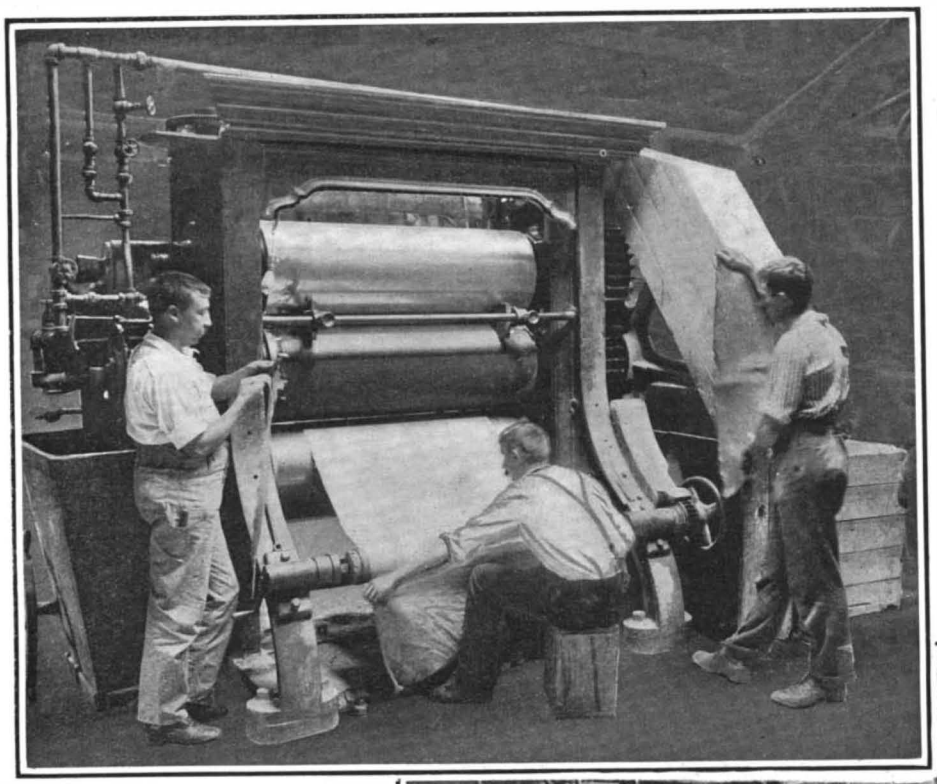
MANUFACTURE OF MECHANICAL RUBBER GOODS.

Could Charles Goodyear, the father of the rubber industry, return to life and visit a modern rubber factory, it is safe to say that his astonishment would be expressed, not so much at the machinery used in the manufacture of rubber as at the materials used in the make-up of the rubber goods of our times. Everyone knows that it is practically impossible to find a pure rubber article on the market in these days, and one often hears the rubber manufacturer arraigned as a conscienceless defrauder. But let the public, which stands in judgment on the manufacturer, stop to consider its own part in the case. One concern informs us that it pays $1.40 per pound, wholesale, for crude Para rubber, and 23 cents per pound for canvas, yet it makes up and sells rubber hose for 25 cents per pound. Problem: Find the profit. There is no method of adulterating canvas, although to be sure it forms a relatively small part by weight of the hose. If any profit is to be made, it must come out of the rubber, and the public which refuses to pay more than one-fifth as much for the finished product as the manufacturer does for the raw material, should find no fault with the quality of goods it receives.



Rolling Uncured Rubber Into Sheets.

Were it not for the invention of a process for reclaiming old rubber, the lot of the manufacturer would be a hard one. Fortunately for him, he is not dependent upon the forests of Brazil or Central America for the precious gum. Rubber has been imported into this country for nearly a century, and since the material is proof against all ordinary deteriorating influences, it follows that the country is stocked with a large supply of the material, in scrap form, to be sure, but rubber nevertheless, and capable of being reclaimed by a simple process and remanufactured into new goods.

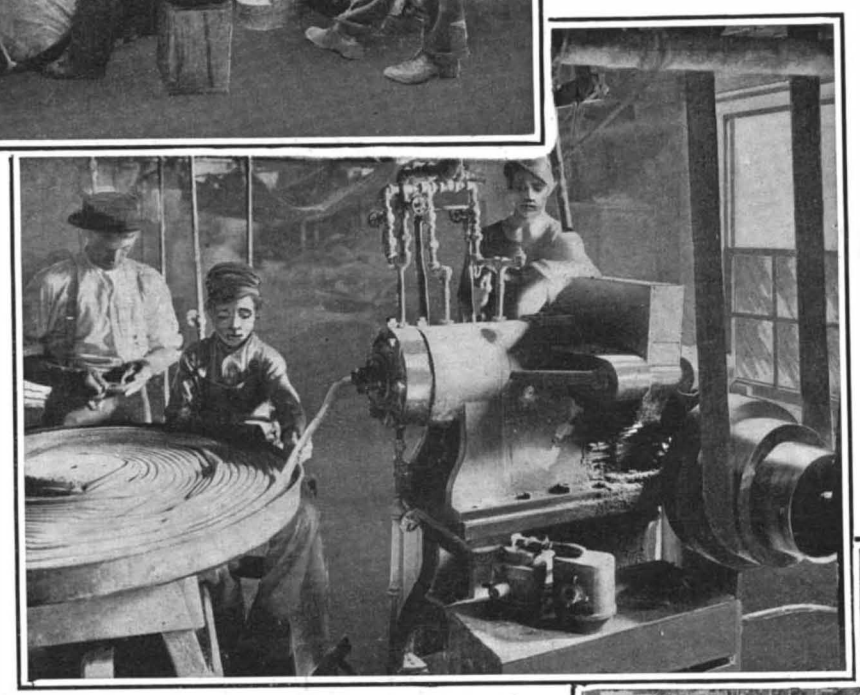
Rubber in its raw, unvulcanized state becomes soft and plastic when heated at a moderate temperature, while cold renders it quite stubborn and hard. The vulcanizing process consists in adding to the gum a certain proportion of sulphur which, when mechanically combined with the rubber and then subjected to heat, gives it a permanent character which is unaffected by variations in temperature. The material may be made hard or soft as desired, according to the quantity of sulphur which is added to it. While the sulphur remains in combination with the rubber, the latter cannot be worked over and remolded into new goods. The devulcanizing, or reclaiming process, consists then in extracting or nullifying the sulphur, and thus reducing the rubber to its original workable state. There are several reclaiming processes in common use, and they form a most important part of the rubber industry.

The following describes the reclaiming process, and also the manufacturing methods employed at the Mercer Rubber Company's plant at Hamilton Square, New Jersey, one of the pioneer mills for the manufacture of mechanical rubber goods.

RECLAIMED RUBBER.

Scrap rubber, or rubber "shoddy" as it is called, is made up principally of worn-out boots and shoes, but includes every conceivable form of worn-out or disused rubber, ranging from old hose (the poorest grade) to the inner tubes of bicycle and automobile tires, which may be as high as 95 per cent pure rubber. The material is first ground very fine. It is then treated by what is known as the "mechanical" process for removing all foreign substances. This process consists of a series of magnets, sieves, and blowers, through which the material passes until every particle of metal and foreign matter is removed.

At the Mercer works, a special machine for this purpose has been devised. It consists of a standard type grinding machine of the largest design, comprising a pair of parallel rollers between which the shoddy is fed. One roller rotates more rapidly than the other, and hence a grinding action results, which grinds the shoddy. The ground shoddy drops onto a conveyor belt, and thence by means of an elevator is lifted up to inclined vibrating screens above the rollers. The finer particles are sifted out, and the coarser particles are automatically returned through the rolls and are reground. From the grinding machine the shoddy issues in a fine, clean powder.



Making Tubes by Forcing Plastic Rubber Through a Die.

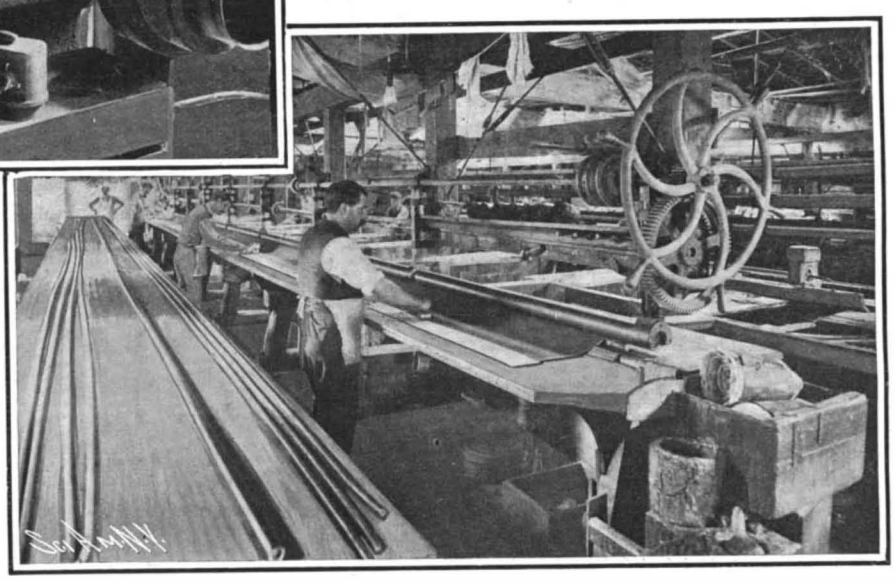
The ground shoddy is then mixed with certain compounds, which combine with and carry off the sulphur in the shoddy when the latter is subjected to heat. It is necessary to have a special mixing machine to thoroughly combine all the ingredients and secure a uniform mixture, on which the reclaiming process depends. The shoddy is now taken from the mixer, and is placed in pans ready to be devulcanized. This is done in a large steam cylinder, in which several tons of the shoddy are run at a time. The cylinder is sealed, and steam is admitted therein to raise the temperature to about 320 deg. Fah. This temperature is maintained for about twenty-four hours, by which time the sulphur is entirely extracted, and the shoddy emerges as an inert, plastic substance. It is then dried, after which it again passes through a grinding machine, so as to reduce it to a form in which it can be readily mixed with the various compounds which go to make up a "batch" of rubber. To be sure, the shoddy contains not only pure rubber gum, but also the compounds of a previous mixture, and it could be formed into various articles without further compounding, except the addition of sulphur. However, it is the practice to add a certain amount of raw rubber and fillers to the shoddy before manufacturing it into new rubber goods. The standard compounding ingredients which go to make up a "batch" of rubber are a quantity of rubber or shoddy, "whiting," white lead, an oxide of zinc, with sulphur in proportions of 3½ to 10 per cent by weight, according to the character of rubber desired. The exact proportions of the ingredients cannot be given, for they vary with different qualities of rubber. The Mercer Rubber Company alone makes use of over two hundred standard formulæ. The materials used for coloring the rubber are, for white, zinc oxide, lithopone, and white rubber; for red, crimson antimony, a red oxide; and for black, lead, litharge, etc. (white lead turns black when acted upon by sulphur). The batch is thoroughly mixed in a grinding machine, and is then ready to be molded or run in the desired form. As a preliminary it is rolled into sheets, which may be of any desired thickness.

MANUFACTURE OF RUBBER HOSE.

In the manufacture of rubber hose the sheets of unvulcanized rubber are cut into strips and fed into a tube-forming machine. This machine is somewhat similar in its action to the common household meat-chopping machine. A worm or screw conveyor feeds the material from the hopper to the tube-forming head. The latter is provided with an aperture of the required size, in which a core is centered. The machine is sufficiently heated to maintain the rubber in a plastic condition, and in this state it is forced through the die, giving it the required gage, and issues from the machine in the form of a seamless tube strongly knit together, which is coiled in a spiral on a slowly-revolving table. The tube may be made in any length desired, because, owing to the soft, plastic character of the rubber, each strip is pressed into the one ahead, and the hose issues without joints. For convenience in handling, the hose is usually cut into 50-foot lengths. In order that it may keep its shape while the canvas reinforcing layers are applied, it is mounted on a long iron rod which snugly fits into the hose.

A rather ingenious method is used for lifting the hose onto the rod. One end of the rubber tube is slipped over the rod, and the other end of the tube is then fitted onto the nozzle of a compressed air pipe. When the air is turned on it expands the tube slightly, and in leaking out around the rod forms a cushion of air on which the rod may be "floated" into the tube. This method acts as a test of the tube, as any imperfection would be developed at this stage of the manufacture. The rubber tube is now thoroughly coated with cement. The rod, with its rubber jacket, is next placed in the winding machine to receive the requisite layers of canvas.

The canvas is coated with rubber in what is known as a "frictioning" machine. This operates on the same principle as the grinding machine. It consists of three rolls, the center roll carrying a bank or coating of rubber, which is kept in a soft, sticky state by means of a moderate degree of heat. The canvas is passed between this roller and the bottom roller, and the roll carrying the rubber revolving at a higher speed than the bottom roller grinds and drives the soft gum through the pores of the canvas, leaving a thin layer which adheres to the cloth. The upper roller serves to keep smooth the rubber coating on the central roller. In this manner the canvas is coated first on one side, and then on the other, after which it is taken to the cutting table. In order to preserve the flexibility of the hose, the canvas must be applied on the bias. At the cutting table it is cut



The Hose Room. Applying the Canvas Strip and Rubber Cover to the Rubber Tube.

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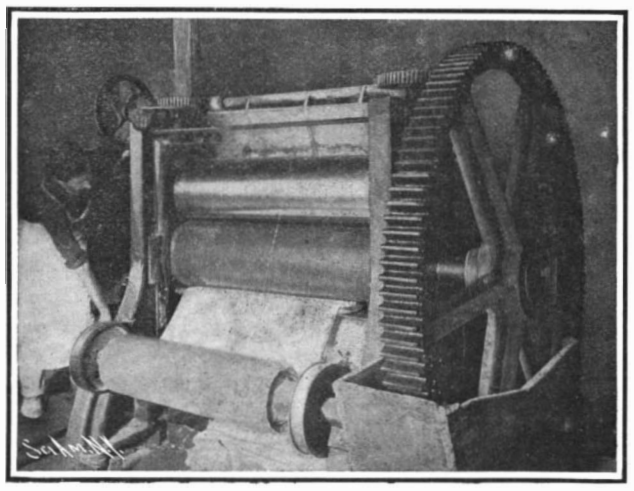
into diamond-shaped pieces, which are cemented together to make a bias strip. The size and number of layers required in the hose determine the width of the canvas strip.

The bias strip is now applied to the tube, which is mounted upon the winding machine. This machine consists of three long rolls adapted to engage the tube throughout its length on three sides. An edge of the canvas strip is inserted between the rolls against the tube. To the opposite edge of the canvas a covering strip of rubber is cemented. On this strip the brand of the hose is stamped. In one of the illustrations a white covering strip is shown attached to the canvas and ready to be rolled onto the hose. When all is in readiness the rolls are set in motion, revolving the tube, and thus winding on the canvas and cover. The covered tube is now put in a wrapping lathe to receive a wrapping of linen before it is cured or vulcanized. It should be remembered that although the sulphur has been thoroughly mixed into the rubber, the mixture is merely a mechanical one, and the necessary chemical combination does not take place until the mixture is subjected to heat. The tube, still mounted on its iron core, is therefore placed in a long cylinder and subjected to steam heat and pressure. The linen wrapping prevents the hose from swelling and becoming distorted during the vulcanizing process. In this cylinder the tube remains from twenty minutes to an hour, according to the quality of the rubber. If the material should remain in the vulcanizer too long, it would become over-vulcanized and lose its vitality. After the hose is thoroughly vulcanized the linen is stripped off, and it is again inflated by compressed air to permit removal of the iron rod. The foregoing description of the manufacture of hose refers to garden hose and conducting hose generally. Fire hose, air brake hose, and other specification hose are made in substantially the same manner, except that the tubes or inner linings are hand made of at least three calenders or layers of rubber, instead of being run from a tubing machine. These hose are all finished by hand, and carefully tested at every stage of the process of manufacture.

FRUIT JAR RINGS.

Closely associated with the making of rubber hose is the manufacture of rubber jar rings; for, contrary to the generally prevailing opinion, the rings are not stamped out of sheet rubber, but are cut from rubber tubing. This is a much more economical process of manufacture, as it entails no loss in waste cuttings. The material is made into tubes on a tube machine of the same type as that used in the manufacture of hose. The tubes are vulcanized, and are placed on a mandrel and mounted in a lathe. The rings are then cut off by an automatic mechanism, which alternately presses a sharp knife against the rapidly-revolving rubber tube, and, between cuts, feeds the knife laterally a distance depending upon the desired thickness of the rings, which is governed by a ratchet. These lathes, as they are entirely automatic, run at a very high rate of speed, reducing the cost of cutting to a minimum, which enables the manufacturer to offer a better quality product to-day, even in the face of much higher prices for raw materials.



"Frictioning Machine" for Coating Canvas With Rubber.

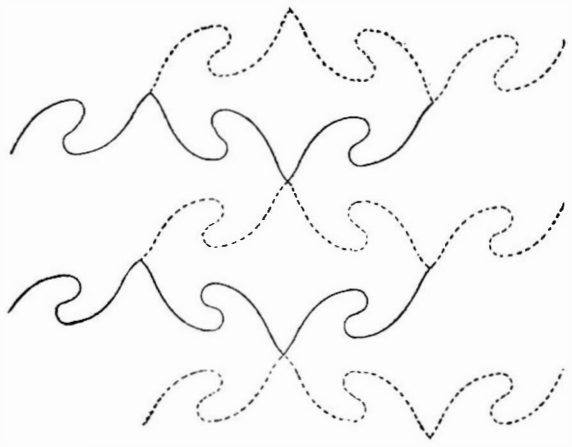
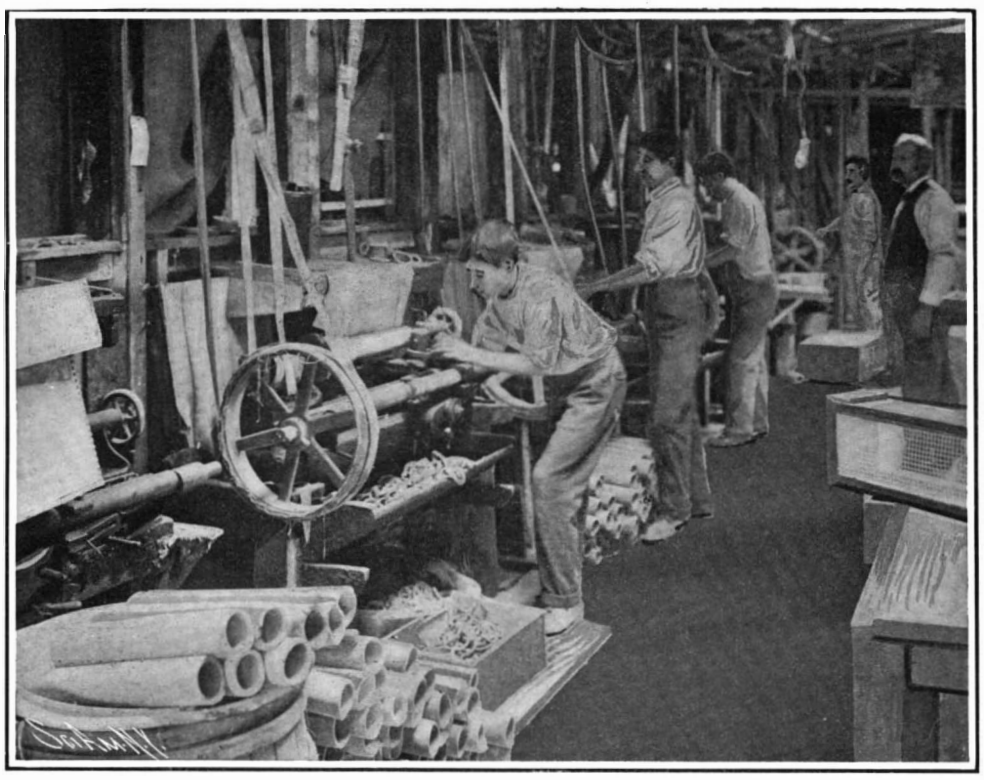


Diagram Showing Lateral Displacement of Tile-Cutting Knife Whereby Both Sides of a Tile Are Cut With Same Knife.



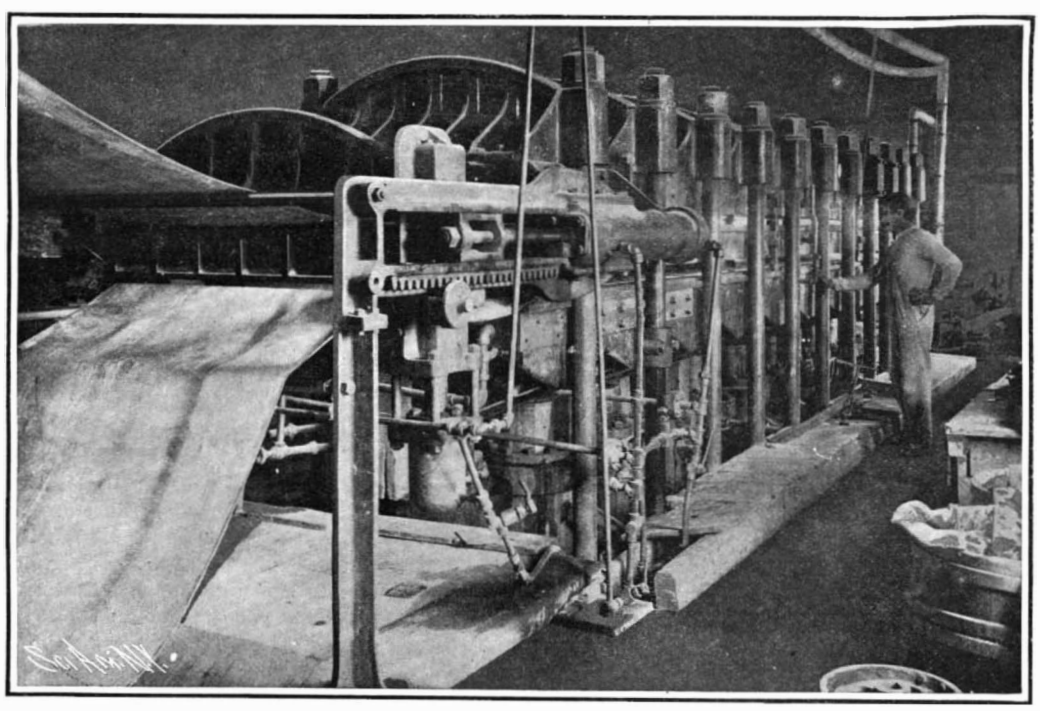
Automatic Lathes for Cutting Fruit-Jar Rings From Rubber Tubes.

INTERLOCKING RUBBER TILING.

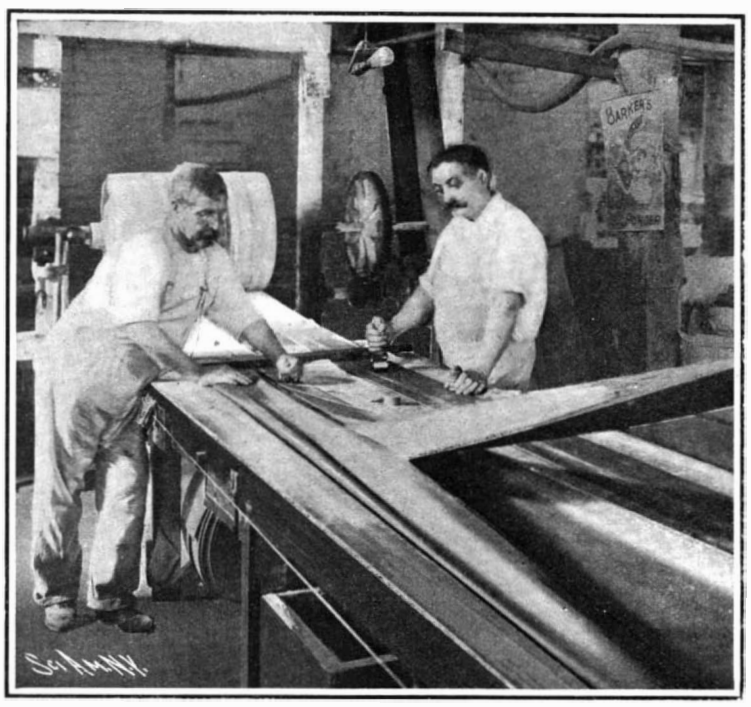
An important part of the mechanical rubber industry is the manufacture of interlocking tile floorings. Heretofore it has been the practice in making the tiles to cut them into shape, and then vulcanize them separately in molds. A different process is followed by the Mercer Company, The rubber is made up into sheets, which are rolled to gage, and then vulcanized in a large hydraulic press, where the material is subjected to pressure which may run up as high as 3,000 pounds per square inch, securing a uniform density and thickness of rubber. Out of this thick rubber sheet the tiles are cut by an ingenious machine, which is fully protected by patents. As shown in the photograph, the tile is of the double-anchor type. With the exception of the border strips, all the tiles are identically of the same shape. It is interesting to note that this form of tile is cut out by a single knife, which first cuts one side and then the other of the tiles. The form of the knife is indicated by full lines in the diagram. After the rubber sheet is cut along this line, the knife is moved laterally while the strip is fed forward, and the next cut is then made along the broken line. The successive cuts are thus diagonally displaced with respect to each other, and owing to the peculiar form of the tile, this displacement permits both sides of the tiles to be cut with the same knife. In making up a mat different colors of tiles are used, and arranged in artistic and geometrical designs.

RUBBER PACKING.

In the making of rubber goods such as steam hose and packings which, in use, are to be subjected to high pressure and heat, the compound must be such that it will not be subject to over-vulcanization. As stated above, if uncured rubber be left in a vulcanizer too long, it is apt to be over-vulcanized. For this reason certain ingredients are mixed into the batch which serve to absorb all excess of sulphur in the composition, so that when in service the packing is heated by steam, the vulcanizing process will not continue. The manufacture of steam packings is receiving a great deal of attention in these days, owing to the increased use of high-pressure and superheated steam. One of the recent forms of packing made by the Mercer Company, and designed for the most severe service, is a combination of the waterproofing qualities of rubber, the heat insulating and resisting qualities of asbestos, and the tensile strength of brass wire. A woven cloth made of brass wire wrapped in asbestos is coated with pure rubber gum. The rubber is placed on both sides of the cloth, and then pressed into the asbestos by means of hydraulic pressure. A principal objection to asbestos for steam packings is that it is disinte-



Hydraulic Double-Deck High-Pressure Press, 30 Feet Long by 50 Inches Wide, Exerting Pressure of 3,000 Pounds Per Square Inch.



Folding Rubber-Coated Duck Strips to Form Belts.

MANUFACTURE OF MECHANICAL RUBBER GOODS.

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grated by moisture. The rubber coating, however, serves to keep out the moisture, and the brass wire in the packing prevents blowouts.

Another steam packing designed for permanent joints comprises a mixture of rubber and graphite. The material is put on the market in its unvulcanized state; but it contains the requisite amount of sulphur, so that when set in place it is automatically vulcanized in the joint by the heat of the steam. The material can thus mold itself to the joint, and will take up any unevenness in the surfaces with which it contacts, but when once it is set it will retain its shape unchanged.

RUBBER BELTS.

The term "mechanical rubbers" is quite a broad one, and covers a great variety of subjects, with which we cannot deal in these limited columns. We have endeavored to describe only such of the principal branches of manufacture as possess particular interest and novelty. But before closing, mention should be made of the rubber belting industry. The belting is made of cotton duck, coated with pure Para rubber. The duck is coated in a frictioning machine in the same way as is the canvas used in hose. The duck strips are assembled in as many plies as may be desired. The strips are rolled together in this form, and are then vulcanized. Rubber belting has the advantage of being very economical, and if properly used will last a long time. Aside from this, it may be used in places where leather belting would not be suitable, because it is not affected by heat or cold, and will not swell in damp weather.

Racing Carnival of the Motor Boat Club of America.

The International World's Motor Boat Championship was won last week by J. F. Anderson's "Irene" over a 30-mile course on the Hudson during the carnival races of the Motor Boat Club of America. The contestants ran thrice over the ten-mile course which was measured from the club station at 108th Street, up the river to Fort Washington Point, down to 64th Street, and back again to the club quarters. In the race on Wednesday E. J. Schroeder's "Dixie," which was twice winner of the international championship and also winner of the Harmsworth cup off the English Channel, was expected to beat its competitor, the "Den," owned by J. H. Hoadley. In this race the "Irene" did not compete, as it had been too badly battered by Tuesday's storm. The result of the race was that the "Dixie" had to drop out owing to carbureter trouble, and the "Den" finished alone in 1 hour, 15 minutes, and 52 seconds. In the second race of the series the "Den" declined to compete, and the "Irene" won from the "Dixie" in 1 hour, 15 minutes, and 7 seconds. In the finals the "Dixie" was unable to race owing to a cracked cylinder, and the "Irene" beat the "Den" by nearly four minutes. The time of the "Irene" was 1 hour, 15 minutes, and 56 seconds, while that of the "Den" was 1 hour, 19 minutes, and 47 seconds. Immediately before the International World's Championship Race was run the "Den" and H. N. Baruch's "Skedaddle" competed for the One Nautical Mile Championship (flying start). In this race, the boats ran a mile three times upstream and thrice downstream, and the average speed was counted. The "Den" won with an average of 25.622 knots, or 29.504 miles per hour. The average of the "Skedaddle" was 23.334 knots, equivalent to 26.1 miles. The contest for the National Motor Boat Championship was won by the "Skedaddle," which retains the title and cup. The Interstate Championship was captured by C. J. Swain's "Sparrow."

Fulton Day at Jamestown.

On September 23 a Robert Fulton celebration was held at the Jamestown Exposition. A spectacular feature of the celebration was a typical representation of what the inventions of Robert Fulton meant to the world. It was the assembling in Hampton Roads just off the exposition grounds of every sort of craft propelled by steam.

While the Italian Lloyds transatlantic steamer "Princess Yolande," 12,000 tons, the largest emigrant ship ever built in Italy was being launched, on September 21, at Rivatrigoso, near Spezia, she heeled over and rushed into the sea on her side and sank. A number of workmen and guests who were on board were saved. The slipway is supposed to have been too steep, and before the vessel floated her portholes plunged under water.

THE NEW PHOTOGRAPHIC MERIDIAN TELESCOPE OF THE PARIS OBSERVATORY.

BY JACQUES BOYER.

The instrument for the determination of right ascensions which is shown in the accompanying photograph has been installed in the Paris Observatory by Profs. Mascart and Ebert. It was designed by Prof. Lippmann, constructed by Gautier, and is based on the following principle:

If a collimator is directed in the plane of the meridian and a cylindrical mirror, with its axis normal to that plane, is placed in front of the lens, the rays which emanate from the illuminated vertical slit at the other end of the collimator will be spread out by the mirror into a plane sheet, which will intersect the celestial sphere in a meridian circle. If these rays fall on the object glass of a telescope, visual or photographic, which simultaneously receives light from stars, the images of the latter will be formed in the focal plane, together with a line which represents the image of the great circle of the heavens (the circle of reference) traced by the luminous sheet reflected from the cylindrical mirror. For convenience the eyepiece of the visual telescope is placed at the side of the tube and the rays coming from the objective are reflected into it by a mirror.

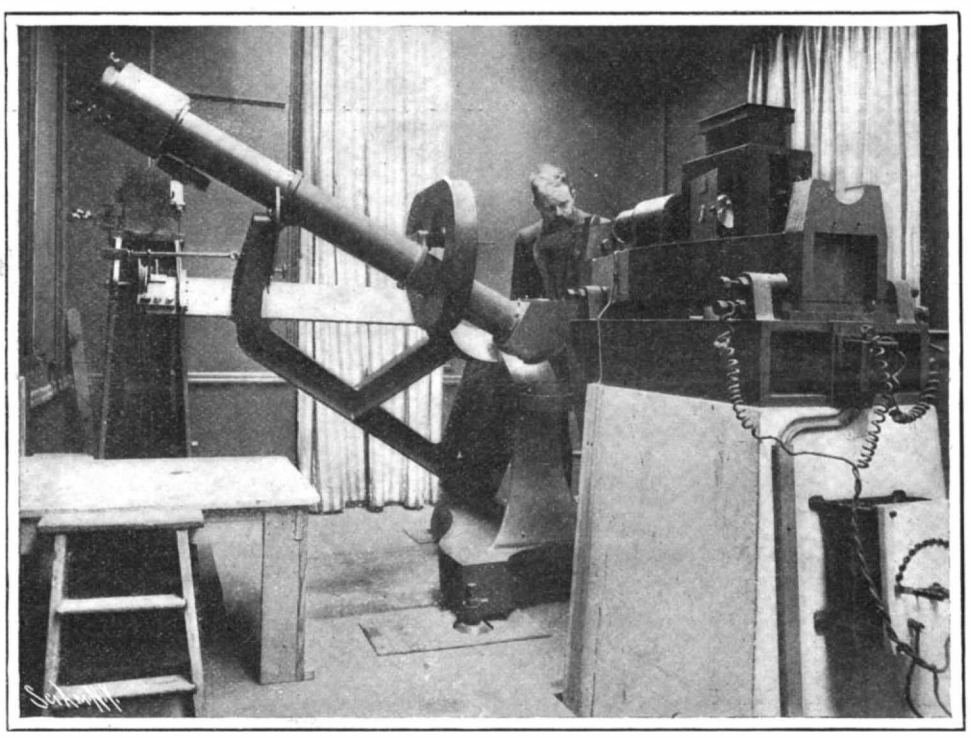
The telescope is mounted equatorially in order to permit long photographic exposures to be made. The diameter of the object glass is 6.3 inches. The slit of the collimator is provided with an instantaneous shutter which is opened and immediately closed once a minute by clockwork. The theoretical field of view of the instrument comprises 180 degrees and stars of the 9th magnitude can be photographed with an exposure of 12 minutes.

The plates show, in addition to stellar images, a number of black lines which are the photographic impressions made by the luminous meridian plane of reference at intervals of one minute. The right ascensions of the stars can be computed from the distances between their disks and the black lines, the clock time being given by the positions of the images of standard stars. The distances are measured with a micrometer and the right ascensions are obtained to 1/10 of a second of arc. About thirty stars are photographed on each plate. Because of the unsteadiness of automatic electric lamps the slit is illuminated by an electric arc which is regulated by hand, and the telescope is shielded from all reflected and extraneous light.

The formulas which are used in reducing eye observations are also employed in this photographic method, in which many data, free from personal error, are obtained in a few minutes. In the photographic determination of stellar co-ordinates it has hitherto been necessary to refer images of faint stars to images of brighter stars on the same plate and then to connect these brighter stars with standard stars by eye observation. Hence it was necessary to know the simultaneous indications of three independent instruments —the photographic telescope, the reticle telescope, and the clock—which in the new method are replaced by a single apparatus.

Profs. Mascart and Ebert are now endeavoring to introduce improvements suggested by their preliminary experiments. In particular, they propose to increase both the length and the diameter of the collimator, to prolong the running time of the driving clock in order to be able to increase the exposure, to devise means of photographing more southerly zones and determining the nadir, and to modify the circuit breaker so that the opening of the slit may be made at regular intervals of any desired number of seconds.

With these improvements the new apparatus may be expected to give rapid and accurate determinations of the right ascensions of the heavenly bodies.



THE NEW PHOTOGRAPHIC MERIDIAN TELESCOPE OF THE PARIS OBSERVATORY.

THE OUTLOOK TOWER OF BEINN BHREAGH, THE FIRST IRON STRUCTURE BUILT OF TETRAHEDRAL CELLS.

BY T. W. BALDWIN.

An experimental structure embodying several new and interesting features of construction has recently been built by Dr. A. G. Bell at his summer home in Cape Breton.

From the general appearance down to the minutest details its construction is a departure from ordinary engineering practice.

Perched up on the top of a hill some 500 feet above the Bras d'Or Lakes, it looks like a huge camera tripod, but in reality is a lookout tower about 70 feet in height, made to demonstrate the tetrahedral principle applied to large structures.

Dr. Bell has used the tetrahedral principle in the construction of his man-lifting kites for some time, finding that it gives a perfectly braced structure of great strength and lightness. It occurred to Dr. Bell that this system might be used to advantage in engineering work on a large scale, and this tower is the first iron structure built on this principle.

The unit cell, which is the basis of the whole tetrahedral system, is the framework or outline of a solid having four sides, as the word tetrahedron implies. The solution of an old trick of making four triangles out of six matches may serve to impress the idea on the minds of some. This is an impossibility if the attempt be made to get them all in one plane, but the moment it occurs to one to make a triangle first and then a tripod of the three other above, it is very simple indeed.

The resultant structure, if the sticks are fastened at the four corners, gives a regular tetrahedral cell, which is the unit of construction analogous to the brick in ordinary building. This miniature truss, made of four triangles in different planes, gives a framework of wonderful stiffness and strength. It also lends itself easily to combinations having the same good qualities to a remarkable extent.

Utilizing this principle, the cells used in the tower were made of ordinary ½-inch galvanized iron piping, secured at the four junction points by cast-iron corner pieces, into which they screwed. The piping was cut into lengths of 44¾ inches, allowing ⅝ of an inch thread in each casting, when the cell measured exactly 48 inches from tip to tip of the castings. One of these cells was subjected to a compressional strain of 4,000 pounds without showing the least sign of failure.

The tower, which is composed of 260 of these cells, rises to a vertical height of about 70 feet above the ground. It rests on three concrete foundations, which go down to bedrock. A glance at these widely separated points of support (72 feet apart in the form of a triangle) at once suggests several questions as to the method of erecting the large tripod structure above them, and herein lies a distinct and useful feature of the tetrahedral system. Employing ordinary methods, its erection would have been very expensive, necessitating an immense amount of staging and falsework; but upon the cellular system of construction it was very simple, and no staging or falsework of any kind whatsoever was required. Practically all the work was done on the ground, the workmen having all the advantages of *terra firma* until the last section was completed.

The plan of erection was a simple one. The leg containing the stair and one of the other legs were first built along the ground, forming a large V. In this position the foot of each leg was securely fastened by a hinge to its foundation; the hinge forming an axis, about which it was free to turn if raised at the junction of the two legs (which corresponds to the point of the V, and was directly above the third foundation).

A system of jack screws was used to do this, and the third leg was built up section by section. For convenience and safety during this operation, an arrangement like a gallows was made, to support the structure while the next section was being bolted on.

It consisted of four braced uprights of stout timber with a cross beam between them. Most of the weight of the structure during a lift was taken upon this cross beam, under which two large jack screws were operated. When the structure had been lifted four feet (the length of one cell) all the weight was taken

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on the cross beam until the next section was firmly bolted in place, which took about four minutes to do on an average. The whole weight on the third leg (always roughly equal to one-third of the completed tower) was then allowed to rest on the newly-added section, the cross beam withdrawn from the section above and reinserted below. This operation was repeated until after a succession of lifts the third leg had its full complement of cells, and the tower was in its final position.

No real difficulty was experienced in carrying out this plan, and the last section came to within a fraction of an inch of its assigned position on the foundation. The tower was formally opened August 31 last.

In an article like like this it is impossible to go very fully into the details of the system and its possible applications, but it may be well to point out a few of its best features.

First. The rigidity of the structure was remarkable. This was well demonstrated by testing the two legs which were built along the ground as a beam. In a position very slightly inclined to the horizontal, 72 feet between supports, the structure only showed a deflection of about ⅜ of an inch.

Second. The whole tower is less than five tons in weight, and is surprisingly strong for the material employed, due to the support afforded to the compression members every four feet throughout their length. A very long through member may thus be safely treated as a comparatively short post.

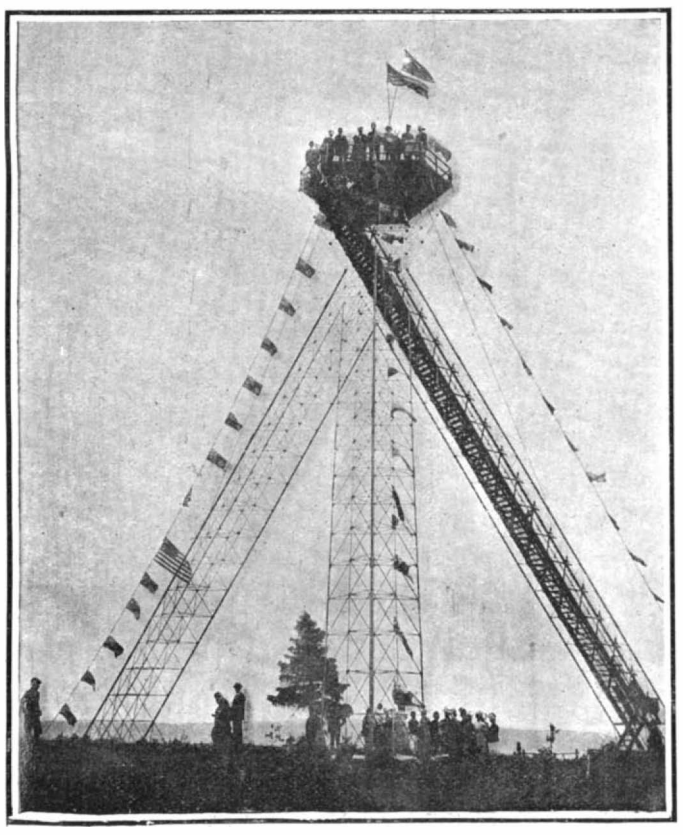
Third. The inspection or even complete renewal of such a structure could be easily accomplished, as no one member is indispensable to its support.

Fourth. The material can be very rapidly assembled, offering special advantage for temporary structures of various kinds.

Fifth. The method of construction reduces the amount of falsework, and in some cases would eliminate its use altogether. Sixth. A very small amount of skilled labor is necessary for good work.

These points appear to be some of the chief ones which make the application of the tetrahedral principle of construction to engineering work on a large scale well worth the consideration of all interested in the subject.

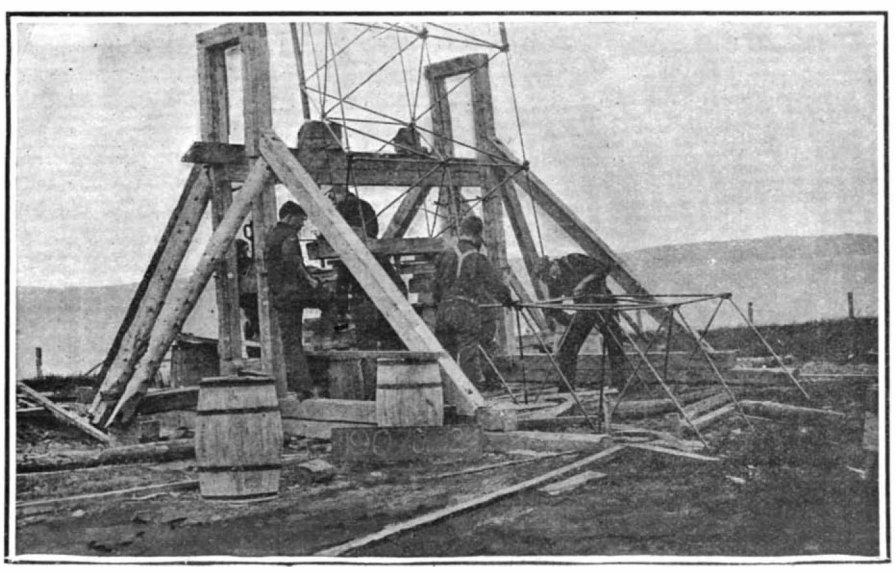
Tetrahedral Units from Which Tower Was Built.



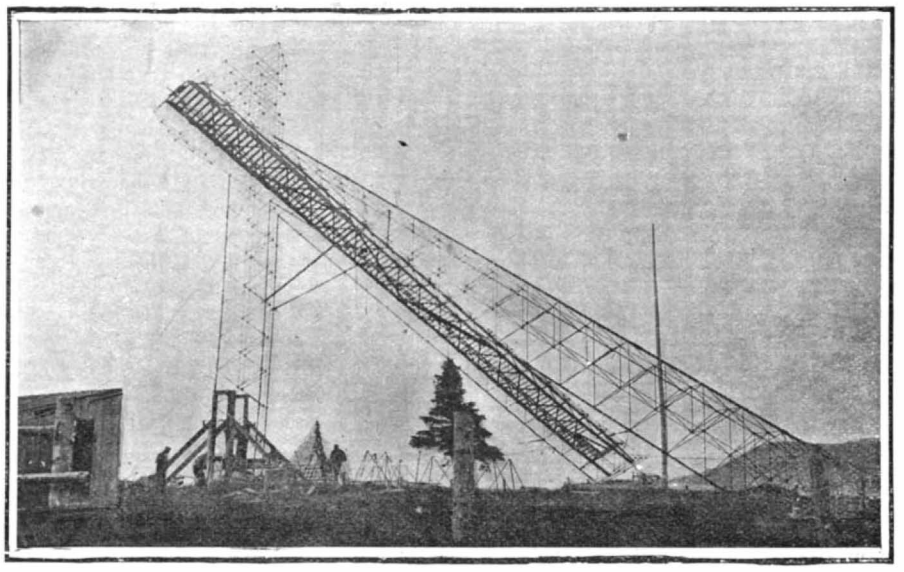
The Completed Tower on the Opening Day.

The Opening. Dr. Bell Addressing the Visitors.

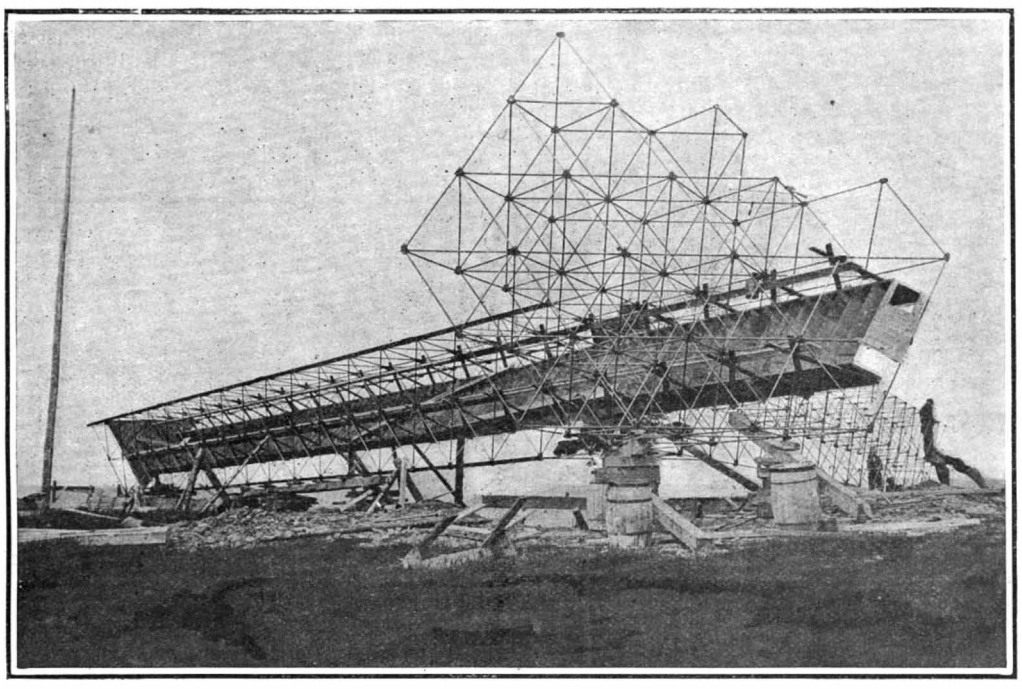
It is the opinion of Albert M. Reese, of Syracuse University, whose pamphlet on the breeding habits of the Florida alligator was recently published by the Smithsonian Institution, that so long as the Everglades and the Okefenokee swamp remain undrained, the alligator is not in the slightest danger of becoming extinct.



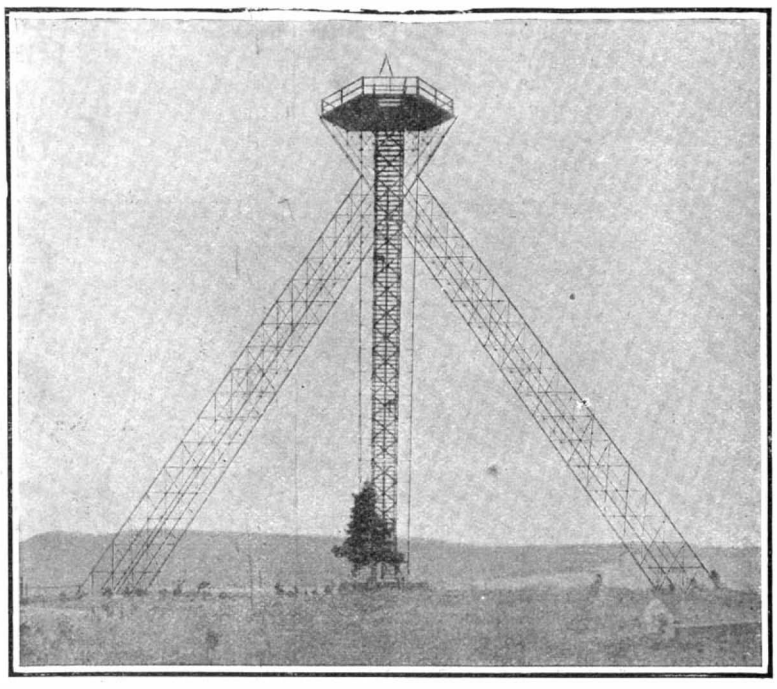
Supporting the Tower on the Crossbeam While a Section of the Third Leg Is Being Placed in Position.



The Tower in Course of Erection, Showing the Members Half Way Up.



Two Legs Completed on the Ground Ready for Lifting.



The Completed Tower, from a Photograph Taken on September 2.

THE OUTLOOK TOWER OF BEINN BHREAGH, THE FIRST IRON STRUCTURE BUILT OF TETRAHEDRAL CELLS.

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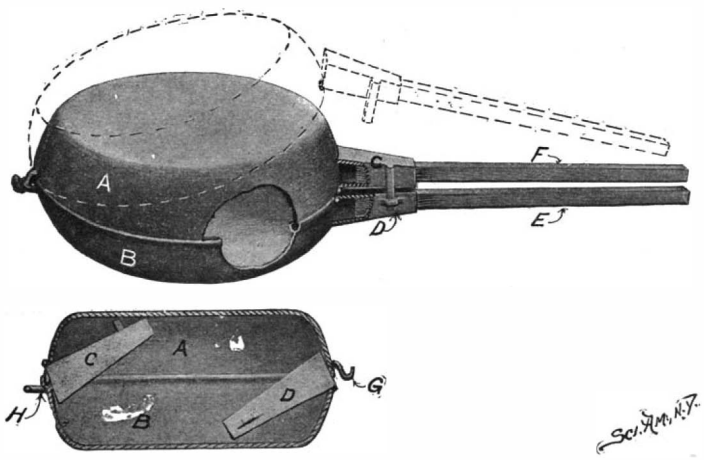
Patent Department

COOKING UTENSIL FOR CAMPERS.

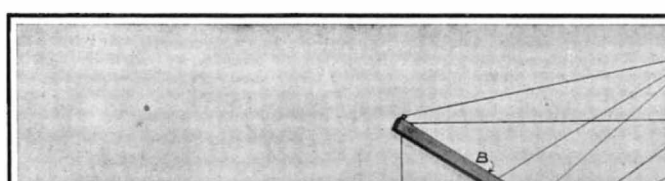
A recent invention provides a simple cooking utensil adapted particularly for the use of campers or others employing an open fire, although it will be found useful for cooking on stoves as well. It comprises opposite pan sections removably hinged together, and forming a closed receptacle. In cooking over an open fire this closed form of utensil is necessary to prevent ashes, cinders, and the like from entering the utensil and contaminating the food, and at the same time it facilitates the turning of the food, as it is merely necessary to turn the pan in order to apply the heat to opposite sides of the food within the utensil. In order that the utensil may be packed for transportation, the handles are so attached that they may be folded within the pans. In the illustration we show the two pans, *A* and *B*, respectively provided with handle sections *C* and *D* hinged thereto. These handle sections are of tubular form, but square in cross section, and taper outwardly from the pans. Handle extensions *F* and *E* are provided, each formed with a tapered head adapted to snugly fit into the handles *C* and *D*. The pan *B* is formed with a recessed rim in which the rim of the pan *A* is received. The pans are hinged together by means of a hook *G* on the pan *A*, which is adapted to engage an eye *H* on the pan *B*. In use the pans are held together by a catch on the handles. If the operator desires to examine the food in the utensil, it is merely necessary to raise the handle extension *F* to disengage this catch, and then force the pan up to the position indicated by dotted lines. One of our views shows the utensil in its folded position. It will be noted that the extensions *F* and *E* have been removed, and the handles *C* and *D* have been folded inside of the pans. Mr. Charles A. Vogler, of Baker, Wash., has just received a patent on this improved cooking utensil.



COOKING UTENSIL FOR CAMPERS.

IMPROVED TRACK-LAYING MACHINE.

We illustrate herewith a machine adapted to be used in laying tracks, to expedite the operations and enabling the work to be done by a smaller number of men. The machine is mounted on a flat car. At the forward end of the car is a gallows frame *A*, and hinged to the front end of the car platform are two booms, *B* and *C*. The boom *B* is preferably longer than the boom *C*. Both of the booms are supported by cables running over frame *A*. At one side of the car is a channel *F*, in which the rails are guided to the front of the machine in laying them. At the opposite side of the car is a similar channel *G*, which serves as a guide for bringing ties forwardly in laying them. The tie channel extends to a great distance ahead of the car, and is supported by guy wires, which pass over pulleys on the gallows frame and are secured to the rear of the car platform. In front of the rail channel *F* is a dolly *E*, consisting of an upright post connected by braces with the forward end of the car, and by an inclined brace to one of the guy wires of the tie train *G*. At the lower end of the post *E* is a roller adapted to support the rails when they are run out from the guy channel *F*. In operation, after a sufficient number of ties have been laid, a rail is run out on the dolly and seized by the grapple of one of the hoisting cables. These cables run from the booms over a pair of pulleys in the gallows frame, and are attached to the pistons of a pair of compressed air cylinders *D*. By relieving the pressure in the proper cylinder the rail may be lowered to the track, and moved into correct alinement by the workmen. The purpose of having booms of unequal length is to provide for laying the rails in staggered arrangement, that is, so that the opposite rails of the track will break joints. The compressed air cylinders *D* are supplied from a tank *H*, in which a pressure is maintained by a compressor mounted on the car. Provision is made for folding down the gallows frame against an upright *J* when the machine is not in operation. A patent on this track-laying machine has been granted to Messrs. W. M. Saxton, P. J. Henselwood, and A. A. Johnson, Box 486, Portage la Prairie, Manitoba, Canada.

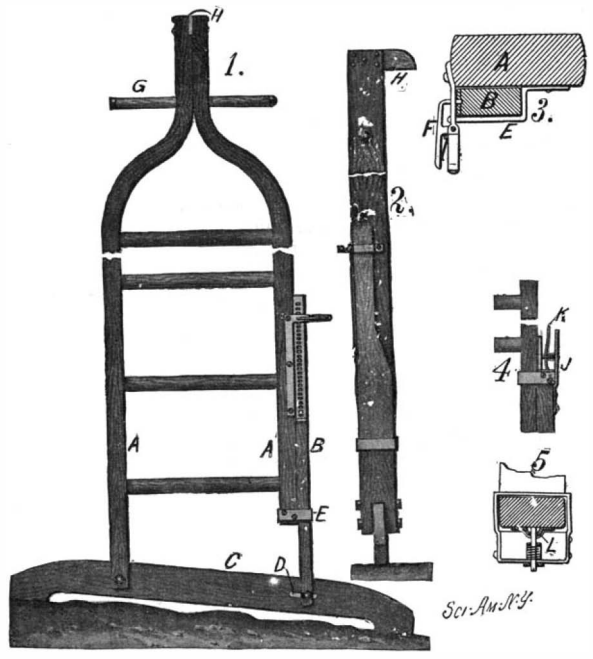


IMPROVED TRACK-LAYING MACHINE.

From the nature of its work, it is generally necessary to make use of a coping saw in very close quarters, and the workman finds that he must frequently remove the saw blade during the progress of the work and replace it in different positions. An improvement recently made in this tool has a ball bearing feature, by which it is possible to turn the saw blade at any angle, and to secure it in this position without taking it from its fastenings.

LADDER FOR USE ON UNEVEN GROUND.

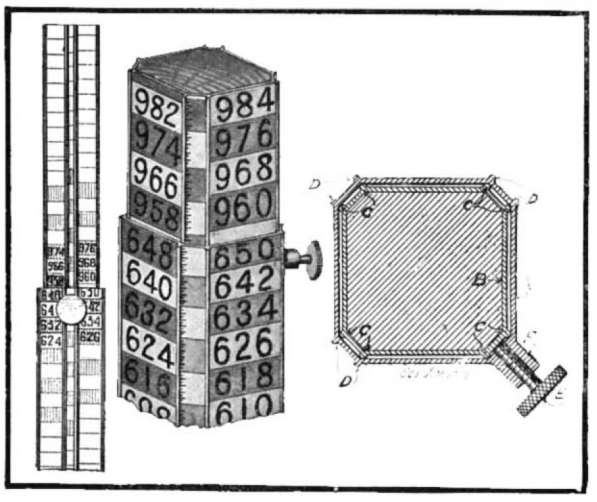
Pictured in the accompanying engraving is a ladder adapted particularly for use in picking fruit from trees. To this end the base of the ladder is so arranged that it will support the ladder in upright position irrespective of the inclination or unevenness of the ground on which it stands, and the upper end of the ladder is so arranged that it may be supported in a crotch of a tree, or against a limb extending at such an angle that the ordinary ladder could not be safely supported thereon. One of the side bars *A* of the ladder is formed with an auxiliary member *B* slidably connected thereto. A bolt at the lower end of the member *B* engages a slot *D* in a base member *C*, to which the other side bar *A* is pivotally secured. The member *B* is held against the adjacent side bar *A* by means of a pair of straps *E*. Pivoted to the upper strap *E* is a latch *F*, adapted to engage the teeth of a ratchet secured on the member *B*. The latch is normally pressed into engagement with the ratchet by a flat spring, and serves to hold the member *B* at the desired adjustment. The side bars *A*, at the upper end of the ladder, are bent together and held by a bolt *G*, which preferably projects to a considerable extent each side of the ladder, and is provided with rounds. At the extreme upper end of the ladder is a pointed metal plate *H*, which in use is adapted to be hooked over a limb, to prevent the ladder from slipping off should the limb bend away when the worker mounts the ladder. It will be evident that by this construction the ladder may be supported in a vertical position, at any time, irrespective of the unevenness of the ground. Furthermore, as the supporting parts of the base member *C* are greater in area than the ends of the side bars, the ladder does not readily sink into soft and muddy ground, and the great length of the base member lessens the liability of the ladder being tipped to one side. A modified construction of the device for adjusting the member *B* is shown in Figs. 4 and 5. On the side bar *A* is a plate *L*, provided with perforations which are adapted to be engaged by a pin, supported in an extension *J* of the upper strap *E*. A handle *K* carries the pin, which is normally pressed by a coil spring into engagement with the perforations. A patent on this improved ladder has been granted to Mr. Hibbard H. Thomson, of Lawrence, Kan.



LADDER FOR USE ON UNEVEN GROUND.

IMPROVED LEVELING ROD.

The accompanying engraving illustrates an improved surveyor's leveling rod. The rod is so designed that it is possible easily to take readings, through a level, to the small fractional part of a dimension, and accomplish this directly without referring to the unit marks on the rod below or above the reading, and without undue straining of the eyes. This result is obtained by covering the rod with graduations on all sides, the graduations of each succeeding side of the rod differing by a fraction of a unit, which gives the graduations a spiral trend thereabout, and provides sufficient space for marking the figures in large type. In carrying out the invention, a hollow casing *A* is employed, which forms the lower portion of the rod. This casing is substantially square in cross section, but with the corners diagonally cut away to form an eight-sided figure. Beads *D* serve to separate the adjacent faces of the casing. Within the casing is a second casing *B*, similar in form to the casing *A*, and provided with beads *C*, which serve the double purpose of separating the sides of casing *B* and acting as bearing surfaces, which fit against the interior of the casing *A*. The casing *B* may be filled with a wooden core, as indicated in the engraving, or it may serve to contain still another casing of similar form, if so desired. On the casing *A*, at one of the flattened corners, a lug *D* is provided through which a set screw *E* is threaded. The set screw bears against the inner casing *B*, and serves to hold the latter at any desired adjustment with respect to the casing *A*. The principal feature of the invention lies in the method of applying the graduations to the faces of the casings. This is clearly shown in the illustration. The numbers are placed only on the four broad faces of the casings, while the narrower corner faces serve to indicate intermediate graduations. The spaces between the different dimensions on the rod are preferably made in alternately different colors, so that they may readily be distinguished. The graduations on the corner faces of the rod may be subdivided, as indicated in the illustration. A patent on this improved leveling rod has been secured by Mr. Federico Wulff, of Torreon, Coahuila, Mexico.



IMPROVED LEVELING ROD.

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RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

COLLAR-SUPPORT FOR SOFT SHIRTS.—H. R. PARKER, Ashland, Pa. The invention relates to shirts, and especially to soft shirts. Collars of this kind have a tendency to sag or fold at the front and present an unsightly appearance. The inventor overcomes this objection so that a collar, though soft, will retain its form.

HAT-PIN.—E. M. BLOCH, Sag Harbor, N. Y. The object of this invention, which refers to improvements in pins, and more particularly to hat pins, scarf pins, and the like, is to provide means for engaging with the pin body adjacent the point thereof for holding the pin in place and preventing its accidental displacement, and means also serving as a protection to the point of the pin.

FOOT-SUPPORTER.—F. F. WEDEKIND, San Francisco, Cal. A form or shape is provided in this case for what is known as flat feet, which will be light and perfectly shaped to the foot, and adapted to be worn in the shoe. The form will maintain its shape and will fit up well around the heel and sides of the foot, extending to the ball thereof, the device extending higher up at the inner instep section than at any other point so as to provide the most support thereat.

DRESS-SKIRT MARKER.—C. KNOPF, New York, N. Y. In this patent the invention has reference to improvements in devices for use in marking around the lower portion of a dress skirt to indicate the proper length or the like, the object being to provide a device for the purpose that will be simple in construction and by means of which the marking may be accurately made.

REEL AND DISPLAY DEVICE FOR VEILINGS, LACES, AND LIKE FABRICS.—J. WINEBURGH and A. WINEBURGH, New York, N. Y., and F. B. IVY, Essex Fells, N. Y. The object of the improvement is to provide a reel and display device for veilings, laces, and like materials, and arranged to hold the fabric properly reeled and a portion thereof displayed over a representation, such as the face of a woman, to effectually indicate the merits of the fabric when in actual use.

GARMENT SUPPORTER. — KATE CONRY, New York, N. Y. This invention relates to garment supporters, and is designed to provide means adapted to be attached to the front and side of a corset, to support hoisery without injury to the fabric thereof, to brace the ankle of the wearer, and to exert a downward pull on the corset without discomfort to the wearer.

Electrical Devices.

GALVANOMETER.—J. RICHARD, 25 Rue Mélingue, Paris, France. The improvements in this case increase sensitiveness of the apparatus by increasing the value of the couple producing rotation, that is to say, by enabling the electromagnetic field produced by the current to act with a constant and maximum intensity on the stationary magnetic field, and they also permit the use of a lever-arm longer than those in the forms heretofore known. This is obtained by moving, in an uniform magnetic field, two of the sides of a galvanometer coil of which all parts are eccentric to the axis of rotation, so as to increase the stability of the moving system.

Of Interest to Farmers.

GANG-PLOW.—A. THOMPSON and G. P. LABERGE, Salem, Ore. The invention is particularly useful in connection with gang plows drawn by means of traction engines and the like. One object is to provide a plow having a plurality of plow shares for the purpose of plowing a number of furrows simultaneously, and having means for automatically raising the plows from contact with the ground when necessary.

DRAFT ATTACHMENT.—J. J. MAGINN and A. E. CARY, Greely, Neb. The improvement is in draft appliances or attachments for plows and harvesters subjected to side draft. The entire attachment may be easily attached to any harvester pole or tongue. In applying the attachment to the tongue of a grain binder, or the beam of a plow, devices are employed comprising bifurcated clips, and a horizontal bar or clevis, the latter being bolted to the above beam and the clips embracing its ends.

BAND-CUTTER AND FEEDER.—C. CHRISTIANSEN, Crookston, Minn. This improvement relates to threshing machines, and more particularly to the mechanism for carrying the bundles of grain to the band cutter as they are fed into the machine, and the object is to provide a carrier which may be very quickly and rigidly secured in place when it is desired to employ the same during the operation of the machine.

Of General Interest.

EXPANDED RECEPTACLE.—O. F. EICHBERG, New York, N. Y. Mr. Eichberg's invention is an improvement in vessels or receptacles formed by expanding from a slitted sheet. In carrying it out he employs a circular blank or the blank may be otherwise shaped according to the design of the vessel to be produced. The body of the vessel is thus cut out of a single plate of material and expanded to desired shape and after it is shaped, reinforced and supported to braces.

SAW-SET.—T. W. CROSS, Everett, Wash. This saw-set comprises a vertical frame having an anvil on its front side, a horizontal forked frame which is adjustable horizontally on said frame, and means for adjusting and clamping it as required, a rotary cam journaled in the horizontal frame in a plane below the top portion of the anvil and a vertically adjustable tooth gage arranged in the horizontal frame and above the anvil.

LABEL-MOISTENER. — H. G. CAMPBELL, New York, N. Y. The principal objects here are to provide means whereby an adhesive can be applied, and which will also be suitable for applying water for moistening previously glued or pasted surfaces. Furthermore, to provide for a quick and ready flow of the moistening agent; for readily locating labels or suitable articles in a position to be moistened; for holding the same while being moistened, and for automatically removing them from the moistening agent.

MARINE VESSEL.—T. S. BARWIS, Vancouver, British Columbia, Canada. The principal object in this case is to provide a vessel with a floatable cabin or deck, which fits in the vessel and is held there solely by gravity, so that it may float out should the vessel founder. Another object is to support the sides of the cabin or deck by gussets, with passages thereunder, so that it will be rigid on the vessel when it floats and will also make possible the easy flotation of the deck or cabin should the vessel sink.

FILTER.—J. B. STEWART, Peregrina, Guanajuato, Mexico. The aim in this case is to provide means whereby when the cyanid solution has been removed so far as possible by settling, the remainder may be squeezed or filtered out and the pump delivered in a continuous stream so low in moisture as to be capable of stacking in dumps, to which it may be delivered by any suitable mechanical means.

FLY-TRAP.—G. W. STEIN, Washington, D. C. This simple trap is arranged on a window pane and against the inner edge of the window sash in such manner that the same is scarcely visible or noticeable from the inside or outside of the window, at the same time this particular location of the trap is arranged directly in the usual path of the flies, making it possible to trap a large number and in shorter time than if the trap were located on the window or sash.

COMBINED ENVELOP AND LETTER-SHEET.—R. C. OZMAN, Beatrice, Neb. The invention comprises a strip of writing paper folded upon itself so as to form leaves or panels for holding the message to be carried, said strip being provided with an oblique fold whereby its general direction is bent at a right angle, and the remaining portion being bent around the portion containing the message and secured thereto.

BOTTLE.—H. S. MARTCHYEN, Maracaibo, Venezuela. The bottle is so constructed that when filled, corked, and sealed, it cannot again be presented as an original package after having been once opened. The construction is simple and economic and the bottle can be conveniently filled and its contents readily discharged.

ADVERTISING DEVICE.—E. N. MONROE, Unionville, Mo. In the present patent the object is the provision of a new and improved device in the form of a pin or shield, arranged for use as a pin, to fasten parts together, and at the same time display an advertisement of the desired character.

ICE-CREEPER.—J. I. HOLDERBAUM, Somerset, Pa. In this creeper the construction is simple and inexpensive. It can be applied to a heel without any skilled help, and the spur section can be adjusted into or out of position for use, and can be quickly removed and replaced as may be desired in the use.

JARDINIERE.—BERTHA C. FEIST, Aspen, Col. This invention relates to jardinières or flower pots such as used for plants used in houses, or for decorative purposes. The object is to produce a jardinière which will afford means for holding a potted plant without exposing the pot or can in which the plant is rooted.

FILTER.—A. J. CLARK, Santa Cruz, Cal. In the present patent the invention has for its object the provision of a new and improved filter, arranged to insure a thorough filtering of the water or other liquid, and to permit convenient and quick cleaning of the filter whenever it is desired to do so.

FIRE-EXTINGUISHING COMPOUND.—E. M. DAVIDSON, New York, N. Y. This compound does not in any way injure or affect any article or substance with which it would normally come in contact while being used. It solidifies only at extremely low temperature, and requires no attention or recharging until used. It may be stored in air-tight bottles and other receptacles, and is not affected by climatic changes.

MATHEMATICAL INSTRUMENT. — L. A. CLAPP, Avon, Mass. The principal purpose of the invention is to provide means for performing a wide variety of calculations and doing away with the use of logarithmic tables for this purpose. The instrument may be used to afford means for providing a graphic solution of problems.

CAMPAIGN-BADGE.—A. JACOBSEN, Hastings, Neb. This patentee's invention has reference to buttons or pins adapted to be worn to display a photograph, picture, printed matter or advertisement, and relates more particularly to means whereby two different photographs, pictures, or the like, may be contained within a single button or pin and either one displayed.

TURPENTINE-HACK.—E. H. WALTON, Bay Minette, Ala. The aim of the inventor is to provide a hack which presents a reversible blade having a plurality of cutting edges. And further to provide a hack having a stock of suitable form and weight and a removable, reversible V-shaped blade having opposite cutting edges and suitably secured to the stock.

VETERINARY INSTRUMENT.—J. TONEY and J. H. VIOL, Deer Lodge, Mont. In this instance the invention is a veterinary dental instrument sometimes designated a "balling ring" and designed to be placed in the mouth of a horse or similar animal for the purpose of holding his mouth open while filing, extracting, or otherwise working on his teeth with a float or other dental instrument.

NON-REFILLABLE BOTTLE.—E. R. RAMSDEN, Jersey City, N. J. One of the purposes of the improvement is to provide a construction, with a universally hinged lever weight acting upon a movable air-inlet valve in such manner that the weight will positively open the valve to permit the escape of liquid in any position the bottle may be given to pour out the liquid, and the weight will also tend to hold the valve open at such time.

ROOFING-TONGS.—F. C. MCCUSKER, Philadelphia, Pa. The tongs are for use in bending or forming the seaming lips used in making the seams. The adjustment gage plate can be set on the lower jaw of tongs so as to form a seaming lip of any desired width. Tinners employ several tongs each designed for forming the lip of a corresponding width. By these tongs the gage plate can be set to form a lip of any suitable width and the plate can be adjusted quickly to position when required.

PALLET-JEWEL SETTER.—L. H. MILLER, Portland, Ore. In the present patent the invention has reference to watchmakers' tools, and its object is the provision of a new and improved pallet jewel setter, arranged to enable the watchmaker to quickly and accurately set the pallet jewels of the pallet. The setter is mounted upon a suitably constructed table provided with legs.

HAMMER.—A. K. HARFORD, Oakland, Cal. In this invention the object is to provide a new and improved hammer, having means driven by the force of an explosive mixture to permit the use of the tool on work which cannot readily be reached by pneumatic hammers and similar tools.

CASING-HEAD.—T. S. CRANSTON, New Comerstown, Ohio. The object of the inventor is to provide a head that will be gas or oil-tight when under extreme pressures, especially avoiding the use of gaskets or packings which are expensive and ordinarily permit gas or oil to seep through the material of which they are composed under high pressure, in such quantities as to result in material loss. The invention overcomes this objection.

CALENDAR AND HOLDER THEREFOR.—T. H. Cox, Newark, N. J. The principal objects of the invention are to so construct a calendar that it can be folded into small compass and brought into position with respect to the holder where any desired turn of the calendar can be readily observed, and to so construct the holder that it can be placed in a watch in position for observation of the calendar attached to the holder.

BOTTLE.—E. H. CAMPBELL, New York, N. Y. The bottle is of the non-refillable type, with simple and inexpensive means in the neck, that will permit liquid to flow readily out when the bottle is tilted, but will effectually prevent refilling; thus not only insuring a purchaser that the liquid in the bottle is that originally placed therein, but protecting bottlers from fraudulent re-use of bottles.

Hardware.

CLEVIS.—M. H. BROWNING, Perry, Ill. In this clevis the pin may be held from turning in the yoke, so that all wear instead of coming upon the metal as would occur if the clevis turned on the pin, will come on the wood through which the pin passes, which is important, as iron against wood is durable, while iron against iron will soon wear out, so the inventor makes the clevis so the pin cannot turn in the yoke with the motion of the evener.

WRENCH.—C. BEAUCHENE, Lake Linden, Mich. This improved wrench is simple and durable in construction and arranged to permit of conveniently and quickly adjusting the movable jaw for gripping nuts, pipes, and other articles of different sizes, to securely lock the jaw in position on the stock after the adjustment is made, and to relieve the locking device of undue strain.

KEY GUARD AND STOP.—H. M. BENEDICT, Cincinnati, Ohio. A purpose of the invention is to provide a guide and stop which will quickly and surely direct a key to the hole when brought into contact with the device at night or day and even when the key-hole is not visible. The device may be so constructed as to be independent of the casing so as to accommodate the device to the hole of any lock in position upon a door.

Heating and Lighting.

THERMOSTATIC CONTROLLER. — C. A. DUNHAM, Marshalltown, Iowa. The object of the present invention is principally to improve the construction and assemblage of the chambered expansion disk employed to actuate the valve or other member, rendering the disk more sensitive and at the same time more durable and easier of operation than such disks previously made. It relates to an improvement in devices disclosed in a prior patent granted to Mr. Dunham.

FIREPLACE-HEATER FOR RADIATOR SYSTEMS.—W. G. CONKLE, Knoxville, Ohio. The improvement pertains to heating systems in which the available heat from open fireplaces is utilized to heat a circulating body of water which, through suitable pipes, is carried through the various radiators of the house and again returned to the heater, so as to secure the advantages of an open fire and utilize the large amount of heat which usually wastes in open fireplaces.

BURNER.—A. G. KAUFMAN, New York, N. Y. The aim of the invention is to provide a burner for use on cooking stoves, gas arms and the like, and arranged to insure a complete mixture of the gas and air, to produce an exceedingly strong flame, capable of quickly and highly heating culinary and other vessels, soldering irons, sad irons, etc., the burner consuming but little gas.

RADIATOR.—G. MENNESSON, Troyes, 18 Rive Droite du Canal, Aube Department, France. The radiator is composed of tubes or elements each formed of a single piece of sheet metal bent down on itself in two parts and welded at its edges. At each end of each tube is formed a circular opening by stamping out to receive a pipe connection. The tubes thus made receive a flat and pointed shape, in cross section, offering several advantages. The element can be applied along walls without giving rise to protuberances, and the triangular form of the element in cross section is favorable to the use of steam and to the draining off of water of condensation.

THERMOSTAT FOR CENTRALLY-HEATED PLANTS.—R. BRUKENHAUS, Haspe, Near Hagen, Germany. The peculiarity of this thermostat consists in the arrangement of a compensating tube which is temporarily passed by the heating medium and closes the main valve or cock at the very moment when the highest predetermined temperature in the room is obtained by means of the movement of the expansion tube, caused by its lengthening through heat. When the temperature is lowered, until a certain minimum is reached, the expansion tube is again cooled and by its shortening the steam cock is opened again.

Household Utilities.

COMBUSTION-CHAMBER FOR GAS OR OIL STOVES.—W. N. BEST, New York, N. Y. The invention seeks to provide a means by which heat will be increased to assist combustion, and siphon sufficient air requisite to promote combustion in the chamber, and to provide means for expansion of consuming gases. Next, to effect highest economy in fuel by controlling and confining the heat in the chamber, not permitting generated heat to waste by passing out under the stove; and lastly, to provide a combustion chamber of such construction that the generated heat will be directed against the object to be heated.

MAT.—W. W. MITCHELL, New York, N. Y. This mat is so constructed as to present a sharp scraping reinforced edge whichever side up the mat happens to be placed. It cannot be flattened out or become bent out of shape by hard usage. It is non-corrodible and easily cleaned. It is adapted for use in cleaning boots and shoes to remove mud or snow therefrom and the object of the invention is to provide a reversible mat of sheet metal very efficient in operation.

DEVICE FOR OPERATING WINDOW-BLINDS.—D. F. LONERGAN, Morristown, N. J. The design in this invention is to improve devices for use in opening and closing the outside blinds of windows, being especially directed to a device operable from the inside of the house, whereby the blinds and shutters may be swung to the desired position without the necessity of raising or opening the sash.

CLOTHES-LINE SUPPORT. — J. LYNCH, Trenton, N. J. The design of this inventor is to provide means for enabling a line to be adjusted at a height convenient for a person standing on the ground, so as to place clothes readily thereon, and then hoisted out of reach, so that the yard may be clear of the clothes, and the latter elevated above the fences into the air, to be quickly and thoroughly aired and dried.

STOVE.—MARION W. RANDOLPH, Seattle, Wash. This stove is for use in apartments or a few rooms where there are no housekeeping conveniences of the usual kind and where odors from gas, oil or alcohol would be objectionable. It is for use in a cabinet of the kind illustrated in a former patent granted to Mrs. Randolph. The present stove or heater has a casing adapted to receive quicklime or the like and a cover therefor, having openings through which cooking vessels may be inserted in the heating medium.

Machines and Mechanical Devices.

ADDING-MACHINE.—C. P. MOORE and T. G. MOORE, Ravenswood, W. Va. The invention is in the nature of a small and convenient machine designed to be carried in the palm

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of the hand and be operated by the thumb and forefinger of the hand sustaining it, leaving the other hand of the accountant free to handle a pencil and keep place in the column of figures as they are added on the machine.

PRINTING-PRESS.—A. G. Halfpenny, West Hoboken, N. J., and A. A. Hopkins, New York, N. Y. In this instance the object of the invention is to provide a new and improved printing press, more especially designed for use in business houses and other establishments, to permit accurate printing of small circulars, bill heads, letter heads, envelops and the like without requiring the aid of an expert printer.

ROCK-DRILL.—E. W. Evans, Greenwood, British Columbia, Canada. Primarily the object of the invention is to simplify the construction of hand-operated rock drills, and to provide for the sliding adjustment of the hammer-suspending mechanism, whereby the same may be readily shifted to any position and permit the striking of the drill with accuracy. It is an improvement in drills described in an application formerly filed by Mr. Evans. This inventor has made another invention of a rock-drill, and its object is to provide a hand-operated drill, more especially designed for drilling lifter and upper holes, and arranged to enable the operator to readily set the tool into the desired position and to actuate it without requiring much physical exertion.

IMPALING-ROLL FOR RAISIN-SEEDERS.—E. L. Chaddock, Fresno, Cal. One purpose of the invention is to provide a roll for raisin seeders and like machines, that may be made of suitable length and yet possess a maximum degree of rigidity throughout, and firm, immovable seats for the impaling saws or combs and their spacing elements.

CLUTCH.—F. H. Bachman, Allentown, and J. D. Bachman, Catasauqua, Pa. The invention refers to improvements in clutches, and more particularly to that type of clutch in which a plurality of movable shoes are supported adjacent and movable into engagement with a rotatable member, and the object is to provide certain improvements in the mechanism for supporting and operating these shoes.

DRILLING-MACHINE.—E. Alsleben, Charlottenburg, near Berlin, 11 Spielhagenstrasse, Germany. Stone drilling machines are known in which the drill pressure is regulated automatically by means of a spring interposed between feed spindle and the drill. It is also usual in stone drilling machines to include a friction clutch in the feed mechanism, which clutch is automatically thrown out when a given drill pressure is exceeded. This invention relates to an electrically operated stone drilling machine, the feed bar of which is arranged in the hollow driving shaft.

PUMP.—A. Dellanna, Salt Lake City, Utah. The invention refers to features of construction and organization in a lift pump in which one or more vertically movable stand pipes are provided in connection with a means, such as pistons, for forcing the water through the stand pipes upon the vertical movement thereof, the pipes being equipped with valves and other parts by means of which the water is caused to flow upward through the pipes from the upper ends thereof.

CONNECTING MECHANISM. — H. E. Smith, Roslyn, Wash. The invention is particularly applicable for the adjustment of the caps of hydrants and the like, and is adapted to be used in connection with the ordinary threaded member of hydrants now in use. It is possible to remove the cap from the hydrant by merely turning the locking member through one-half of a revolution and without rotating the cap member.

BELT-SHIFTER.—A. Rosenthal, Augusta, Ga. This shifter is adapted to be tripped and then to operate automatically for stopping a machine when a certain movement thereof has been made. It is designed for application to any form of machine in which a belt requires to be shifted from a driving to a loose pulley, and the form of support or means for attaching the same to such machine may be varied at will.

SHIFTING AND LOCKING MECHANISM FOR FRICTION-BAND CLUTCHES.—J. P. Karr and J. D. Rauch, Logansport, Ind. The mechanism is applicable to drums of hoisting engines for use in locking them to a countershaft which is driven from an engine or other motor. It is adapted to lock the drum automatically when the mechanism is adjusted in a certain position, but the locking and releasing of the friction band applied to the drum may be easily and quickly effected.

PIPE-CUTTER.—F. G. Haas, Springfield, Mo. In this construction of cutter the inventor dispenses with the use of springs, small screws, pistons, wedges, cams, gears, and other small elements commonly used that readily become inoperative, particularly when provided with screw thread attachments which become loosened or break off when the device is in use. The invention relates to means for cutting boiler flues, tubes, or pipes.

STRIKING-COMB FOR SLASHERS.—H. B. Beckman, Newburgh, N. Y. It is the principal object of the improvement to do away with one-half the labor required to manipulate combs. This is attained by mounting a striking comb for dividing the yarn into an equal number of threads in the form of tape upon the frame of the slashes so that it can be manipulated from one end and by one person easily, and without any accurate work by the employee.

NUMBERING APPARATUS.—O. G. Bartusch, New York, N. Y. This apparatus is more especially designed for use on printing presses and arranged with one or more numbering devices on the same rock-shaft for printing one or more sets of numbers simultaneously, the numbering devices and the oscillating device for the rock-shaft being shiftable on the latter independently one of the other, to allow grouping the numbering devices as desired, the casings of the devices being of the same width to permit of locking them simultaneously in place in a chase or the like.

RELEASING DEVICE FOR THE MATRICES IN COMPOSING-MACHINES WITH TWO OR MORE MAGAZINES PLACED ONE ABOVE THE OTHER.—C. A. Albrecht, 17-18 Chausseestrasse, Berlin, Germany. In order to convey the matrices from the magazines to the assembler by means of the common guide chute, by common magazines also, the lower edges of the exits of which are in a right angle to the upper horizontal surfaces of the magazines, the inventor provides a common guide chute, of several parts, in such a manner that one part which directly communicates with the magazines can be moved parallel with the surface of the lower exits of the magazines while the other part or parts can be adjusted corresponding to this movement.

MACHINE FOR CORRUGATING SHEET METAL.—G. B. Johnson, 8 Victoria Street, Westminster, London, England. The object of the present invention is to render a machine more readily adaptable for producing corrugations of any desired pitch (with certain limits), and to this end it consists in providing means whereby adjustment of the stops lengthwise of the roll arbors may be effected simultaneously for some or all of the stops by simple operation not involving dismounting of the rolls. It relates to a sheet metal corrugating machine described in Letters Patent of the U. S. of A., formerly granted to Mr. Johnson.

Prime Movers and Their Accessories.

STEAM-TURBINE.—J. K. Clark, Honolulu, Ter. of Hawaii. One of the objects in this instance is the provision of a light but strong and durable engine, especially designed for automobile use. The inventor further contemplates a turbine easily reversed or brought to a quick stop, and provides for the utilization of the exhaust steam to lubricate the transmission gear inclosed in a protective casing arranged at one side of the engine.

INTERNAL-COMBUSTION ENGINE.—C. J. Mundhenk, Freeport, Ill. The object in this case is to so construct a gas, oil, or other engine as to permit cooling thereof by an air blast, as contra-distinguished from water cooling. A cylinder and jacket formation produces an inclosed chamber or series of chambers through which air blast is circulated, and in which are arranged radiating devices dissipating the heat from the cylinder proper, and means for maintaining the cylinder in true form. Thermostatically controlled means are provided to automatically regulate the blast.

ROTARY EXPLOSIVE-ENGINE.—J. Van B. Ranck, Cleveland, Ohio. The invention relates to a rotary explosive engine in which two chambers are provided, the charge being drawn by suction into one chamber and therein compressed, and then transferred to the explosion or working chamber where it is ignited and expanded against the piston or equivalent part of the invention.

SPARK-PLUG.—G. W. Sage, Eureka, Cal. Mr. Sage's improvement relates to an igniter of the make and break or contact and release type, adapted for firing the charge of gas or internal combustion engines, and the object of the invention is primarily to provide an igniter of this type which may be used effectually on high speed engines.

ENGINE.—J. Schaeffers, New York, N. Y. In connection with internal combustion engines in which heat of exhaust gases is used to generate vapor employed to actuate a piston in a cylinder provided for the purpose, this invention is particularly useful. The object is to provide an engine in which water or other liquid is injected into the internal combustion cylinders at the end of the power strokes, thereby forming a vapor which is exhausted into a cylinder to actuate the piston therewithin.

INTERNAL-COMBUSTION ENGINE.—P. F. Thomas, El Paso, Texas. The object in this case is to eliminate all cam shaft operating mechanism or other means for opening and closing the valves, and to provide a structure wherein the valves are opened and closed automatically by the pressure of exhaust gas near the end of the power stroke. It is particularly adapted to engines having a plurality of cylinders and of the four-cycle type.

ROTARY ENGINE.—S. S. Sadorus, Sarilda, Idaho. The engine piston and the abutments within the casing may be substantially like those shown in the patent formerly granted to Mr. Sadorus. His present engine employs means to secure the benefit of the expansion of steam, and he also makes the cut-off valves in two parts in the form of disks overlying each other and having openings which may be adjusted into full register or partially out of register in order to control the amount of steam fed to the engine; and adjusts these valve plates relatively by mechanism operated from the piston, so that the feed of steam may be regulated by the engine's speed.

Railways and Their Accessories.

JOURNAL-BEARING.—F. E. Harden, Atlanta, Ga. It is sought in this improvement to provide a self centering and adjusting bearing of long life, which will not at any time allow the spindle to wabble or get out of proper position with respect to the other parts of the train, and which will permit of quick and easy repair when the bearing becomes entirely worn out.

EMERGENCY AIR-BRAKE APPLIANCE.—H. W. Meigs, Birmingham, Ala. The invention is an improvement in emergency stops for railway trains in which a movable device is attached to a fixed object, or structure, located alongside the track, and is adapted for engagement with an attachment on the locomotive, or the cars, whereby an alarm signal may be given, or air pressure in the train be reduced so as to cause instant application of the brakes.

CAR-FENDER.—H. M. Lambert, Portland, Ore. Two fenders or catchers are provided in this instance, one behind the other, the fore fender being particularly adapted and intended to catch a standing person, and the latter a person lying on the track. The fore fender will lift on passing over a recumbent body and allows the rear fender to drop to the track and drag along the same, preventing the body passing under the wheels. The front fender is constructed for readily folding out of the way.

RAILWAY-SWITCH.—J. A. Coppock, Pinehurst, Ga. The switch belongs particularly to that class in which the points lap the head of the main rails on top, whereby the use of frogs or breaks in the main line is avoided, so that danger is eliminated, the track when the switch is open being continuous as to both rails, and the points being so constructed as to lift the wheels to cause the flanges thereof to clear the main tracks when the train is taking the switch.

SPIKE.—A. B. Lipscomb, Yager, Cal. This improved spike is cheaply constructed, since it requires but little more manipulation than the ordinary one, and when once driven into the tie, it will not easily become loose, and even if loose would be very difficult to withdraw since the loosening is at the upper instead of at the lower end.

Pertaining to Vehicles.

FOOT-WARMER.—C. H. Whitaker, Bordentown, N. J. In the present patent the object of the invention is the provision of a new and improved foot warmer more especially designed for use in carriages and other vehicles and places, and arranged to permit the use of lap robes without danger of setting fire to the same or causing overheating.

VEHICLE-WHEEL.—G. R. Williams, Little Rock, Ark. This wheel is especially useful for automobiles. The object of the inventor is to produce a wheel which will have a high degree of resiliency, so as to reduce jars and shocks incident to passing over a rough roadway. A feature is the absence of a pneumatic tire, the general purpose being to avoid delays incident to puncturing such tires.

VEHICLE-SPRING. — G. W. Loeffler, Tampa, Fla. The springs embodying the invention are formed of a steel bar or rod, a portion of which is formed into a head consisting of a series of horizontal spiral coils, and a part extending therefrom, said part having an intermediate vertical coil, and the ends of the bar so formed provided with means for attaching to the vehicle body and axle respectively.

VEHICLE-SEAT LOCK.—J. Arcoren, Rosebud, S. D. One purpose of the invention is to provide a device for holding the seats of a vehicle upon the body thereof, which device is capable of being readily secured to a seat and is so constructed as to receive the upper edge portion of a wagon box and to automatically lock itself thereto when the seat is unoccupied.

TRACE-HOOK. — H. Applegate, Long Branch, N. J. The invention is especially useful in connection with devices of this character having spring pressed tongues adapted to prevent the traces from becoming detached from the whiffletrees. The object is to provide a device of easy manufacture, in which the tongue of the closing member of the hook may be opened by a simple manual operation, and in which parts liable to wear by use are inclosed in a boxing.

AUTOMOBILE.—E. Hyslin, Kindred, N. D. The supporting steering or driving gear for motor vehicles in this case is of that order which embodies a four-wheel drive in which the power is at all times applied equally to all four wheels, and in which both axles or all four wheels are used in steering. Slipping, skidding, and sliding when running on various kinds of roads or on inclines or abrupt turns are prevented.

Note.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Notes and Queries.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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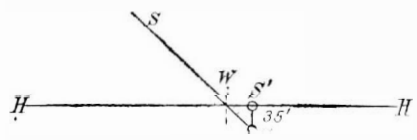
(10619) C. W. T. writes: Please allow me to correct an error into which you fell in a recent issue. In effect the question was this: Why does the sun shine on the north side of a house, at sunset, on the equinox, which stands east and west, when it should set in the west? I don't remember whether he spoke of its shining on the north side of the house at sunrise; possibly he had not noticed that. He asked if it was caused by refraction. You said that it not only couldn't be caused by refraction, but couldn't be true, and proceeded to demonstrate it. Now, I beg that you will permit me to show you that you are wrong. It *is* refraction which causes it, because it appears to rise before it is due, hence is still north of east, and it appears to be in the heavens after it has actually gone below the horizon, and north of west.



H H is the western horizon, *S S* the apparent path of the sun, *W* is a point due west of us (the point where the sun should disappear) *S'* is the point where the sun *seems* to set, when it is actually below that point, and is *north* of *west* from us, and is shining on the north side of the house. *W S'* is the distance north of the east or west point of the horizon to the center of the sun. A. You are quite correct in the theory of your criticism of our answer regarding the shining of the sun on the north side of a house at the equinoxes when rising or setting. We had never calculated the amount of displacement of the sun to the north due to refraction, but upon the reception of your letter we quickly did so, as perhaps you have already done. This displacement varies with the latitude, of course. The refraction of the atmosphere at the horizon is 35 min. of arc. The angle made by the path of the sun with the horizon on any day is the colatitude. This gives a right spherical triangle in which the refraction (35 min. as above) is on one side about the right angle, the displacement to the north to be computed is the other side about the right angle, and the known angle is the colatitude. The equation of this triangle is sine X = cot. of colat. × tan. 35 min. Solving this for the tropics, lat. 23 deg. 30 min., we obtain 15 min. 10 sec. For the latitude of New York the sun is displaced 30 min. 10.5 sec., which is a little less than its own diameter. On the Arctic and Antarctic circles the displacement is 1 deg. 20 min. 30 sec. less 1½ diameters of the sun. The mean diameter of the sun is 32 min. of arc. Within the frigid zones the displacement increases rapidly till at the poles the center of the sun is raised 35 min. above the horizon, which raises the lower limb of the sun entirely above the horizon by an amount a little more than the diameter of the sun's disk. The conclusion is that nowhere excepting in the frigid zones is the displacement at the equinox sufficient to be detected without a compass, or some other accurate method of locating the east and west line. It is not enough to justify the expression that the sun may shine on the north side of a house. One could not be certain of 1 deg. 20 min. by the eye. The rays would not fall into north windows of a house whose walls were accurately oriented, at this angle. Our first answer was sufficiently correct for the place of the inquirer, even if not so for the frigid zone.

(10620) J. A. writes: I would like very much if you would do me the favor to inform me, if possible, the different temperatures that have to be attained for welding iron and steel. A. There is no common and important industrial operation for which theoretical rules and figures may be laid down with so little assurance as for welding, principally because in no other does so much depend upon the individual skill of the operator. Also there may be a difference of 100 or more degrees between one man's idea of say "white heat" or "clear orange" and another's, dependent upon the susceptibility of the retina of the observer or the light under which the observation was made. An expert of the highest standing will positively assert that "steel can

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not be welded," and a manufacturer will produce an elaborately tested weld of the most difficult combination of high and low carbon steels. With the foregoing reservation, the following figures are approximately correct:

Iron to iron: 2350 to 2450 deg. Fahr.

Iron to steel { iron 2400 deg. / steel 2150 to 2300 deg.

Steel to steel: 2100 to 2250 deg.

A white heat will completely destroy some classes of steel; generally speaking, the milder the steel the easier the weld. If two pieces of steel of different melting points are to be welded together, the welding heat of one may be near the melting point of the other, and their temperature should therefore be different in order that the effect of the hammer blow may not affect one more than the other. See SCIENTIFIC AMERICAN SUPPLEMENT, Nos. 70 and 563; price 10 cents each mailed.

(10621) C. W. W. asks: Will you kindly give me the dimensions of a wagon bed to hold one yard of crushed rock? Also, what will one yard weigh? A. A wagon measuring 5 feet long by 2½ feet wide by 2 feet high, inside measurements, will hold almost exactly a cubic yard of crushed rock. To determine the height of the sides necessary for any existing wagon box to make it hold a yard, multiply its length inside in inches by its width and divide 46,656 by the figure you obtain; the answer will be the height of the sides. The weight of a yard of crushed rock will vary considerably with the kind of rock, the size to which crushed, and whether or not it is screened. Granite and gneiss weigh 4320 to 4590 pounds to the yard in the solid, trap rock 4600 to 5000 pounds, and limestone up to 5500 pounds. Screened crushed rock will contain 45 to 55 per cent of "voids" (or spaces between the pieces) increasing with the size to which it is crushed. Thus, a yard of granite, weighing say 4500 pounds in the solid, crushed to say 1½-inch gage and screened so as to contain 50 per cent voids would weigh

$$\frac{4500 \times 50}{100} = 2250 \text{ pounds.}$$

The "run of the crusher" contains only about 35 per cent voids, on account of the varying size of the pieces; thus a yard of crushed trap unscreened would weigh

$$\frac{5000 \times 65}{100} = 3250 \text{ pounds.}$$

(10622) W. S. S. says: I notice in "Experimental Science" a description of a Wehnelt interrupter for an induction coil. Would the law allow any person to make this device to use with their own induction coil? Is it patented in this country? If so, where could one be bought? A. The Wehnelt interrupter of "Experimental Science" may be made and used by any one. It is not patented. It can be bought from any dealer in electrical goods or in physical apparatus for colleges.

(10623) F. B. says: I am constructing an induction coil whose dimensions are as follows: primary coil 8 inches long by ⅞ inch diameter, wound with two layers of D. C. C. magnet wire No. 14. The secondary consists of 2¼ pounds of No. 36 D. C. C. wound into sections 3½ inches by 5/16 inch thick. If hard-rubber tubing is used between primary and secondary, what thickness should it be? Is it necessary to put sheet rubber between each section? What size spark should this coil give, and how far will it work on a wireless. A. A hard-rubber tube 3/32 or ⅛ inch thick will be quite strong enough to use between the primary and secondary winding of your coil. Sheets of hard rubber are the best material to separate the sections of the secondary coil. If properly proportioned a coil of the size you specify will give a spark of about 1½ inches. The coil may transmit to a distance of over two miles over water and at night. You would do well to have our SUPPLEMENT No. 1363, price 10 cents, as a guide in your work of making a wireless outfit.

(10624) P. S. writes: In one of your answers you said that the best way to load a wagon was to put a larger weight on the rear (larger) wheel. Drivers do not agree with you. A man always loads sand as far front as possible. They say that the closer the horse the easier it can be pulled. Please answer in your column which you think would be the best way to load for traveling on macadamized roads. A. Practical men, drivers and others, often follow a certain practice sound in itself, attributing its origin to reasons which are unsound or different from those from which it originated. The practice of loading sand, e. g., nearer the front of the wagon probably arose from its being less liable to run when so loaded; in a four-wheeled wagon, in which the position of the load has no effect on the upward or downward pressure of the shafts, the distance of the load from the horse can make no conceivable difference in the ease with which it can be pulled *on a straight pull.* The distribution of the load will make a difference in turning, a lighter load on the front wheels making the wagon turn more easily, especially on bad roads. A wheel is a continuous lever of the second order, in which the power has the same arm as the weight, consequently there is no reason in theory why a load can be moved more easily on a large than on a small wheel, though a mistaken theory that it can may have assisted the practice. In practice it probably can, the difference decreasing as the surface of the road improves.

NEW BOOKS, ETC.

THE ECONOMICS OF RAILROAD CONSTRUCTION. By Walter Loring Webb, C.E. First edition. New York: John Wiley & Sons, 1906. 12mo.; cloth; 324 pages; 34 figures. Price, $2.50.

The railroad engineer has an almost limitless field to cover before he can be said to have mastered the science of steam-road operating. He must have, in addition to a knowledge of the mechanical details, a wide view of a large number of subjects which on first sight do not seem to have any bearing upon his profession. Should the engineer rise to an administrative position, his view must have an even wider scope. He must be familiar with many questions of economics, and of finance in addition to his technical experience. It is self-evident then what a task the author of a book on railroad economics has before him. Realizing the impossibility of introducing all the subjects related to railroading into a volume of practical size, or of keeping a discussion, from all standpoints, of the more common ones within reasonable limits, the author has approached the topic from the side of economics, and has given most attention to the subjects that have to do with the construction cost of railroad systems.

THE FORAGE AND FIBER CROPS IN AMERICA. By Thomas F. Hunt, M.S., D.Agr., Professor of Agronomy in the New York State College of Agriculture at Cornell University. New York and Chicago: Orange Judd Company. Illustrated; 428 pages; cloth. Price, $1.75.

This is a book for the farmer, the teacher, and the college student. It has been prepared with the view to meeting the demand for an untechnical but scientific and comprehensive treatise of the grasses, legumes, and fibers. The method of presentation is similar to that of "The Cereals in America" to which book this is proposed as a companion, the two books together purporting to furnish a year's work in a college course in agronomy. The book is admirably adapted to general reading and will undoubtedly take its place among the handbooks on agricultural topics. To timothy, Kentucky blue grass, red clover, alfalfa, cowpeas, and cotton has been given the same plain, thoughtful, and accurate treatment which characterizes "The Cereals in America." An abundance of new and scientific thought has been crowded into these pages. Reproduction in grasses, permanency in meadows and pastures, the role of legumes in soil inoculation, the production of root crops as a substitute for the more expensive concentrates, fiber crops in their economic relations, the detection of adulterations and impurities are some of the salient features. Laboratory exercises are provided, and ample collateral reading is supplied at the end of each chapter.

SOLUBILITY OF INORGANIC AND ORGANIC SUBSTANCES. A Handbook of the Most Reliable Quantitative Solubility Determinations. Recalculated and Compiled by Atherton Seidell, Ph.D. New York: D. Van Nostrand Company. 8vo.; cloth; 355 pages. Price, $3 net.

Quantitative solubility tables taken from the most reliable obtainable sources. Designed to meet some of the needs of all chemists, rather than to completely fill the requirements of only one class.

PLANT BREEDING. Comments on the Experiments of Nilsson and Burbank. By Hugo de Vries. Chicago: The Open Court Publishing Company, 1907. 12mo.; cloth; 352 pages; 114 figures. Price, $1.50 net.

The great Darwin, in his theory of the development of one species from another by successive differentiation and natural selection, held that the process was slow and gradual, and that the changes, slight though they might be in themselves. took effect owing to cumulative action. Working from this basis, he calculated that for the forms of life to have reached their present condition, several thousands of millions of years would have been necessary. This estimate does not agree with that reached by physicists and astronomers—among the former Lord Kelvin—who have placed the time during which the earth has been habitable at between twenty to forty million years. Such a discrepancy must needs be accounted for, and the noted Hugo de Vries, Professor of Botany in the University of Amsterdam, seems to do so in a recently published work by modifying Darwin's ideas through the introduction of the principle of Mutation. It has been shown that while species possess constant characteristics in the main, a certain freedom of variation from the general type is possible within limits governed by the rules of probability and chance. These "mutations" or "sports" breed true, and a definite new species results. This, in very broad form, is the foundation upon which the theory of mutation is laid, a foundation proved by experiment to be stable. When applied to the development of species, this modification reduces the unwieldy time interval of gradual evolution to a close conformity with the figures arrived at by other considerations, and the weightiest argument of the opponents of "Descent" loses its force. It is worthy of mention that Prof. de Vries gives at once a very just criticism and well-deserved appreciation of the work of Luther Burbank, the producer and developer of so many useful variants of old species of plants. In criticising Mr. Burbank's work, Prof. de Vries states that it is not of true scientific value, because the methods of obtaining the desired results are not carefully noted, and are largely forgotten as soon as the results are obtained. On the other hand, he strongly brings out that Burbank is not working for scientific ends, but to place on the market improved fruits, more beautiful flowers, and vegetables of greater food value, so that the entire world may benefit by his discoveries. He is the practical worker, who points out the path for the scientist to follow.

SANITARY ENGINEERING WITH RESPECT TO WATER SUPPLY AND SEWAGE DISPOSAL. By Leveson Francis Vernon-Harcourt. With 287 illustrations. London and New York: Longmans, Green & Co. 8vo.; cloth; 469 pages. Price, $4.50.

The scope of this very valuable work can best be gained from an inspection of its contents. The work consists of two parts. In Part I., Chapter 1 contains the introduction and treatment of ancient water works and available rainfall. Chapter 2 treats of sources of water supply. Chapters 3 and 4 treat of wells and of deep wells respectively. Chapter 5 is on lakes and storage reservoirs. Chapter 6, earthen and rubble reservoir dams. Chapter 7, masonry dams. Chapter 8, typical masonry dams. Chapter 9, intakes and conveyance and storage of supply. Chapter 10, purification of water supply. Chapter 11, distribution of water supply. Part II. deals with sewage disposal, and Chapter 12, the first chapter of this part, takes up the subject of house drainage and disposal of refuse. Chapters 13, 14, and 15 deal with sewerage and the clarification of sewage and utilization and purification of sewage on land respectively. Chapter 16, the last chapter of the work, is on chemical, electrolytic, and bacterial purification of sewage.

GRAPHICAL HANDBOOK FOR REINFORCED CONCRETE DESIGN. By John Hawkesworth. New York: D. Van Nostrand Company. Quarto; cloth; 64 pages; illustrated. Price, $2.50.

This work consists of a series of plates, showing graphically, by means of plotted curves, the required design for slabs, beams, and columns under various conditions of external loading, together with practical examples explaining the method of using each plate. Designs for most of the more commonly occurring forms of reinforced concrete construction may be ascertained directly from these plates, without performing any of the computations ordinarily required.

INSTRUCTIONS TO INSPECTORS ON REINFORCED CONCRETE CONSTRUCTION. By George P. Carver. Beverly, Mass.: Payson Publishing Company. Paper. Price, 50 cents.

A set of directions as to the use and inspection of reinforced concrete construction, taken from instructions to inspectors on reinforced concrete arch construction, prepared for use on the viaduct work in Key West of the Florida East Coast Railway.

DAS WERDEN DER WELTEN. Von Svante Arrhenius. Leipsic: Akademische Verlagsgesellschaft, 1907. Octavo. Price, $2.

It has rarely been our good fortune to review a book which has the distinction of having been written by one of the world's great physicists in a semi-popular style. That distinction undoubtedly belongs to Prof. Arrhenius's new book. Considered in its entirety, the work presents in a clear and forceful manner the cosmogony of its distinguished author, a cosmogony which is ultra-modern in every respect, and based almost entirely upon the newer conceptions in physics. Most remarkable and original are those chapters which seek to explain many cosmical phenomena (comets' tails, solar phenomena, zodiacal light, evolution of nebulæ) as the effect of radiation pressure. Although radiation pressure was not discovered by Arrhenius, we owe to him its application to the explanation of most cosmical phenomena. For that reason those chapters which will probably be read with most interest are those on radiation pressure, and above all, the very daring and exceedingly plausible final chapter on "Panspermy," in which Prof. Arrhenius seeks to show how by means of the mechanical pressure of light minute germs of life may be transmitted from star to star.

PRACTICAL CARPENTRY. Edited under the Supervision of William A. Radford. Assisted by Alfred A. Woods and William Reuther. New York: Industrial Publication Company. In two vols. 8vo.; cloth; 500 pages; ill. Price, $2.

The aim of this work is to deal with the subject of building and construction in a systematic and concise way. The author first treats of the subject of geometry in so far as it relates to carpentry. Another chapter is devoted to the use of the steel square, and contains a number of useful suggestions, especially along the line of roof framing. In discussing the subject of house framing, the good and the faulty methods of construction are given, with a view to bringing out the errors common in the trade. The other numerous departments of this valuable work are fully dealt with, giving directions so concise that, in connection with the accompanying illustrations, they cannot be mistaken even by the merest beginner.

ADVERTISING THAT TELLS; OR, HOW TO ADVERTISE IN A SMALL WAY SUCCESSFULLY. By George Carl Mares. London: Guilbert Pitman. 16mo.; cloth. Price, 60 cents.

Advertising is not merely the insertion in a number of publications of a few random statements. It is not the placing before the public of disconnected notices in which is neither coherence nor sequence. Advertising is a science, an art, depending for its success upon a knowledge of human nature and of psychology. In addition to the above knowledge, the successful advertisement writer must be familiar with the methods in vogue in printing establishments. He must be conversant with all the processes of wood engraving, of electrotyping, and of lithography. Then there are questions of cost, of tracing results, and a host of others. In spite of its convenient size, "Advertising That Tells" contains a helpful or suggestive hint, at least, on each of these subjects.

A TREATISE ON THE DYNAMICS OF A PARTICLE. With numerous examples. By Edward John Routh. Cambridge: The University Press, 1898. 8vo.; cloth; 410 pages; numerous explanatory figures. Price, $3.75.

In the dynamics of a particle are so many questions of interest that this branch of the sciences has always been eagerly followed. This is especially so, since, although finite bodies are governed by the same laws as are particles, great mathematical difficulties arise as soon as the finite size of a body is taken into consideration. Many of the problems in this treatise can be attacked from several sides, but, in general, the most elementary method has been put first. An endeavor has also been made to separate the difficulties of pure geometry from those of dynamics by treating all problems in two dimensions before regarding them from a more difficult viewpoint.

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AND EACH BEARING THAT DATE

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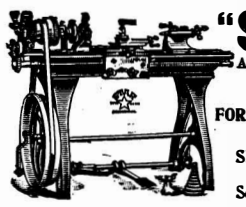

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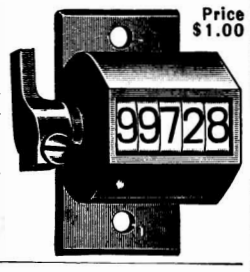

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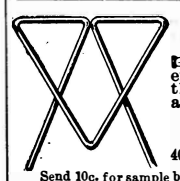

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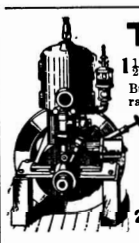

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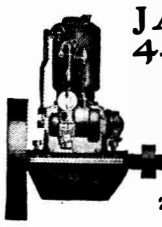

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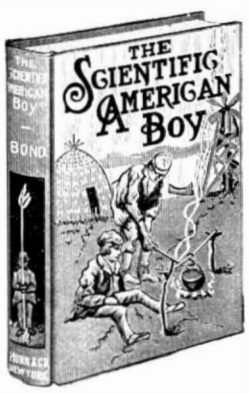

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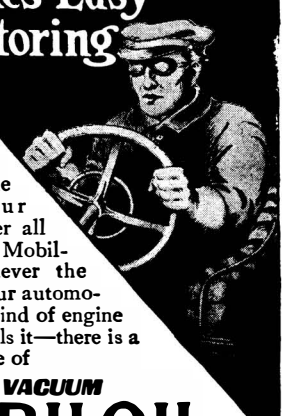

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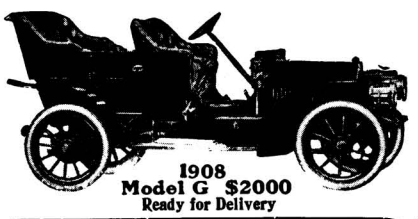

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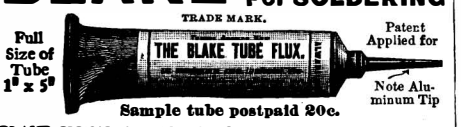

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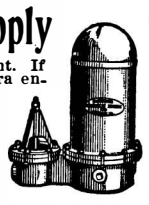

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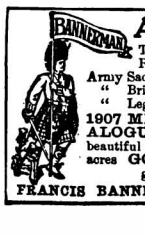

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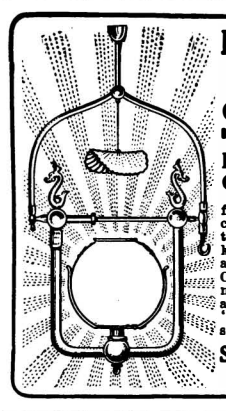

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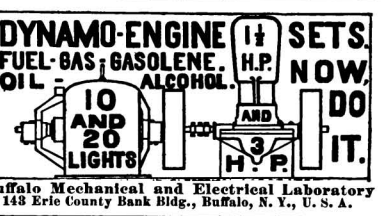

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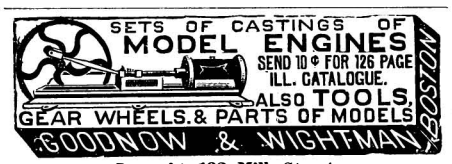

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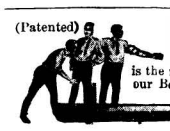

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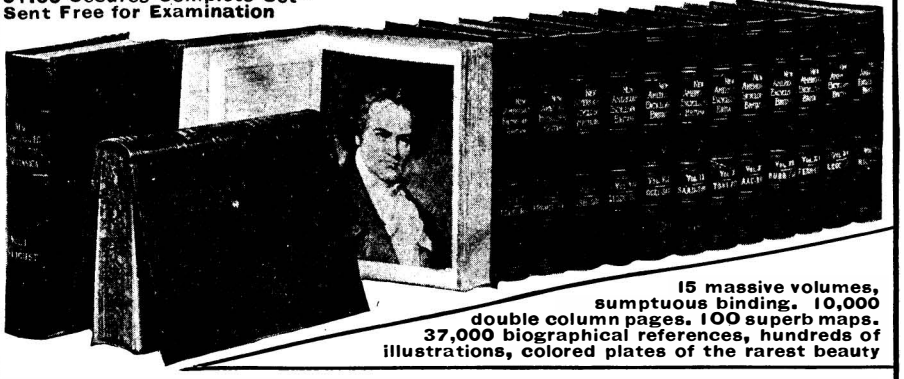

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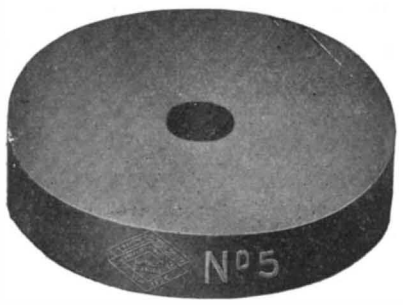

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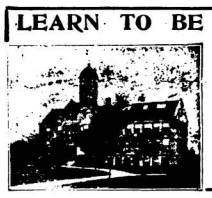
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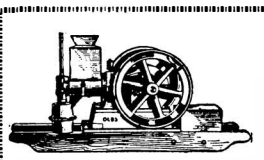
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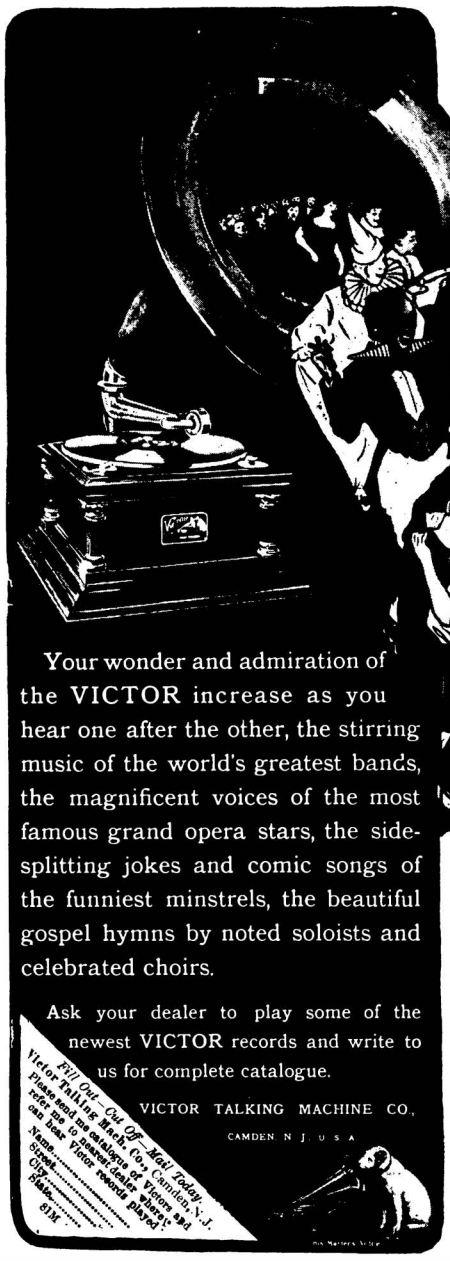
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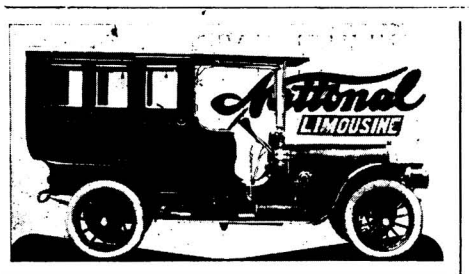

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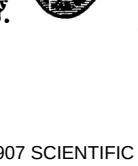

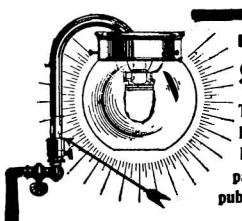
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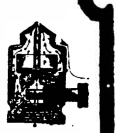
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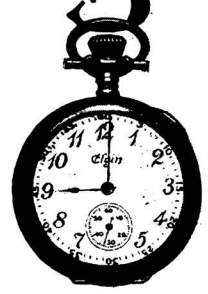
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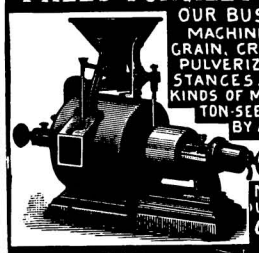
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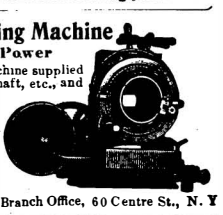
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